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YPG PROJECT NO. 0818/0832

YPG REPORT NO. 7010

MTA TERRAIN IDENTIFICATION

SUPPLEMENT TO FINAL REPORT

ON

ENGINEER DESIGN TEST OF MOBILITY TEST ARTICLES

MODELS BX-1 AND GM-1

BY

F. E. NORTHON
JUNE 1967

YUMA PROVING GROUND
YUMA, ARIZONA

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USATECOM PROJECT NO. 1-7-7670-70/71

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MTA TERRAIN IDENTIFICATION

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ENGINEER DESIGN TEST OF MOBILITY TEST ARTICLES

MODELS Bx-1 and GM-1

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F. E. NORTON

JUNE 1967

YUMA PROVING GROUND
YUMA, ARIZONA

FOREWORD

This supplementary report contains soil identification data common to both the Bx-1 and GM-1 Mobility Test Articles.

Yuma Proving Ground was responsible for preparing the test plan, test execution, and preparing the test report.

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SECTION 1. INTRODUCTION

To reduce the volume of each MTA report (Ref a and b, App 3.9) and because portions of data are common to both reports, this separate MTA Terrain Identification Report has been prepared.

SECTION 2. TERRAIN IDENTIFICATION

The aerial photographs were taken at elevations of 200, 500, 1500, 2000, 3000 and 4000 feet. These photographs were taken with a Speed Graphic 4x5 camera with a 135-mm lens. Full negatives were enlarged to 8 by 10 inches, and the prints were cropped and printed without size change. A 2 foot by 4 foot white panel, for size reference, was placed in the areas photographed.

Selected typical areas one meter square on the Clayton Hills and OTTER courses were photographed (App 3.1, 3.2 and 3.3) geologically described and analyzed for particle size distribution (App 3.4). Photographs of particle size distribution are contained in Appendix 3.5.

The profile of the Clayton Hills Course (App 3.6) was determined at 1/2-meter elevations by rod and transit. Also, a "roughness profile" was determined by running a "roughometer" over the courses. This instrument consists of two wheels, each 37 inches in circumference, on a 14-inch wheelbase coupled to a trailing arm on a Polecat tracked articulated carrier. The pitch of the "roughometer" (determined by a gyro) and distance traveled (magnetic pick-up on wheel) was recorded on magnetic tape, and forwarded to NASA, MSFC, Attention: R-AS-AT, for use in a computer simulator program.

Ground and aerial photographs of the Ogilby Hill Rock Course are presented in Appendices 3.7 and 3.8, respectively.

SECTION 3. APPENDICES

3.1 AERIAL PHOTOGRAPHS OF CLAYTON HILLS AREA

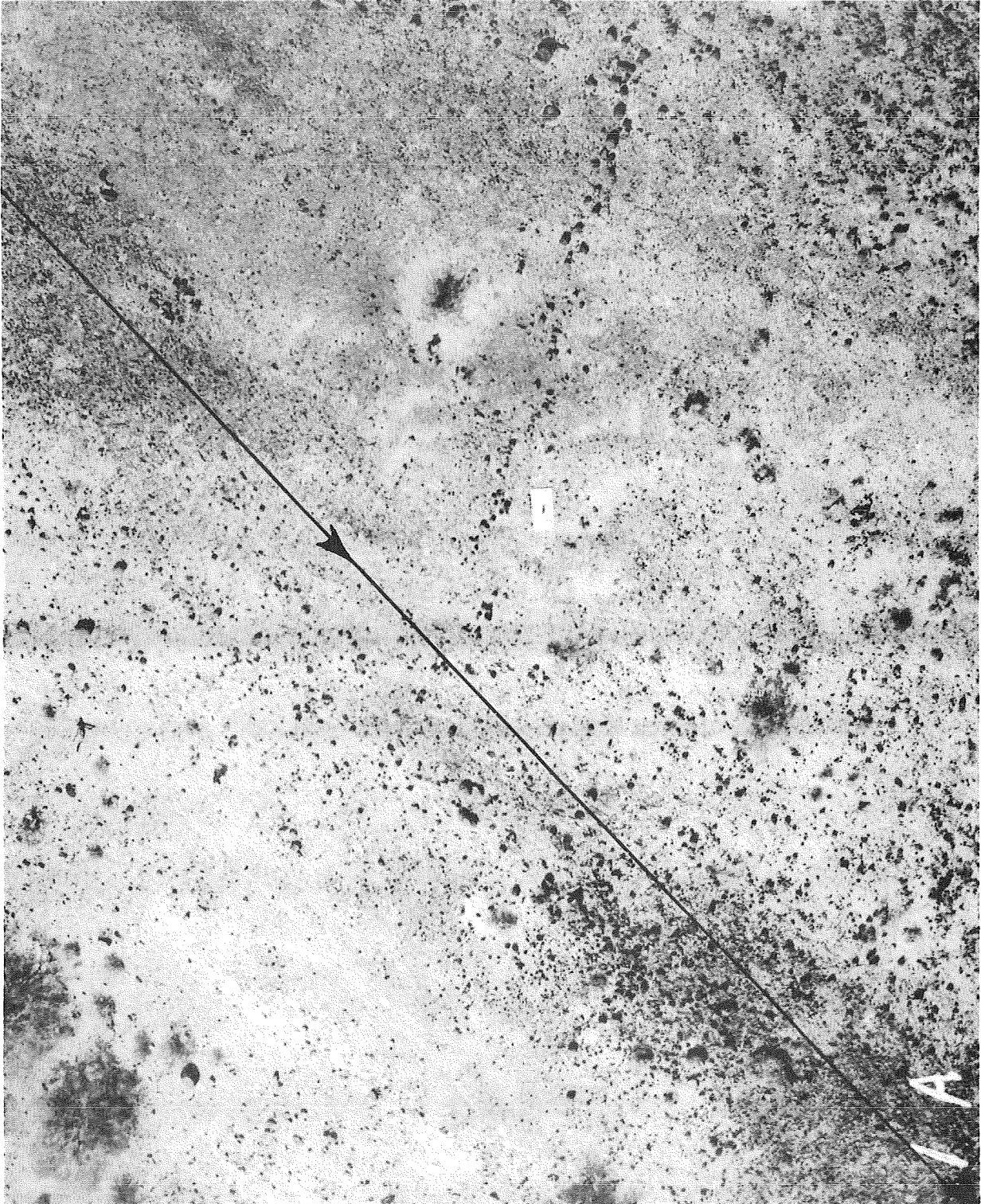


FIGURE 1. Clayton Hills, west loop, 200 feet. White panel is 2 by 4 feet. Arrow on line indicates direction on course.



FIGURE 2. Clayton Hills, east loop, 200 feet.

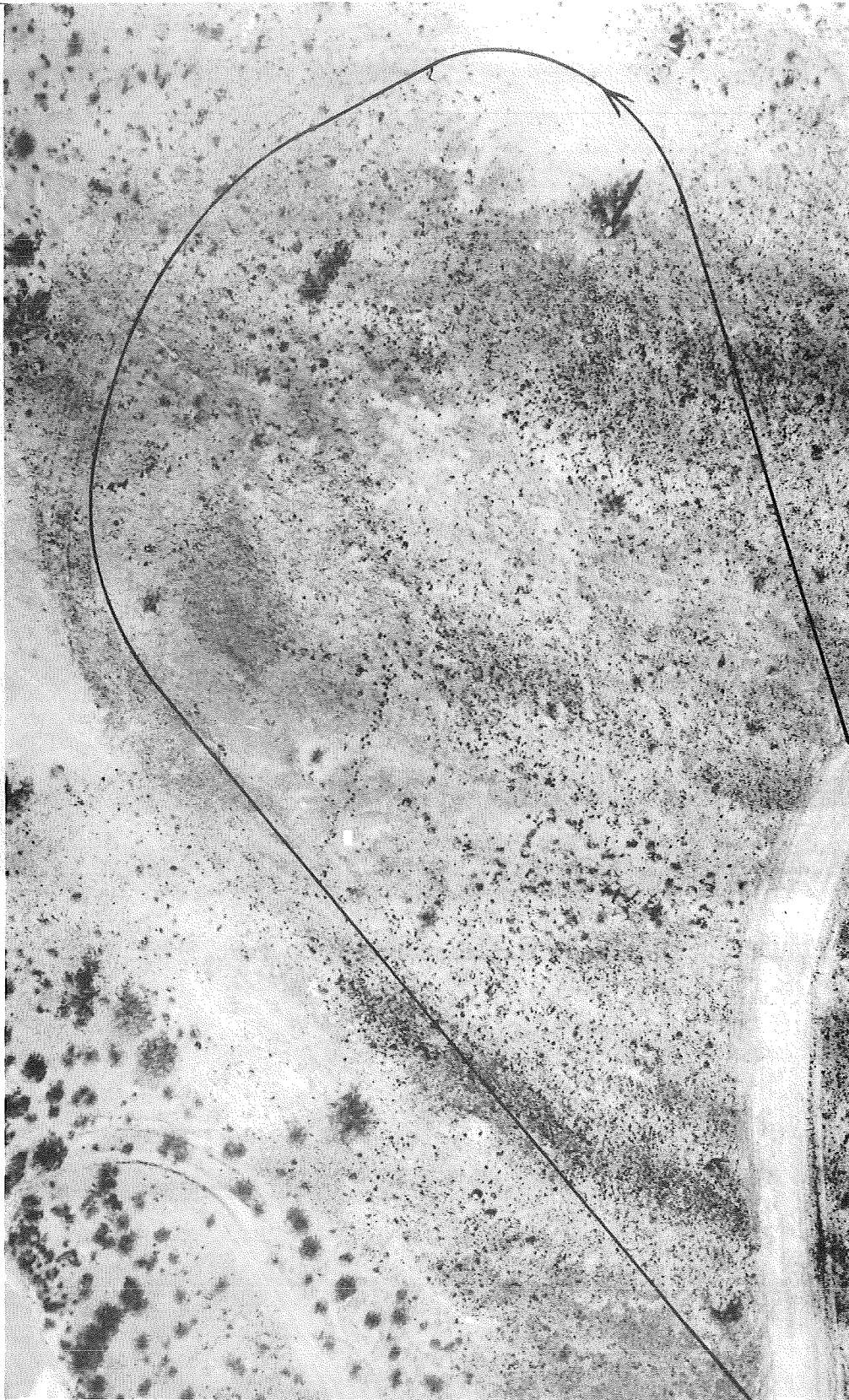


FIGURE 3. Clayton Hills, west loop, 500 feet.

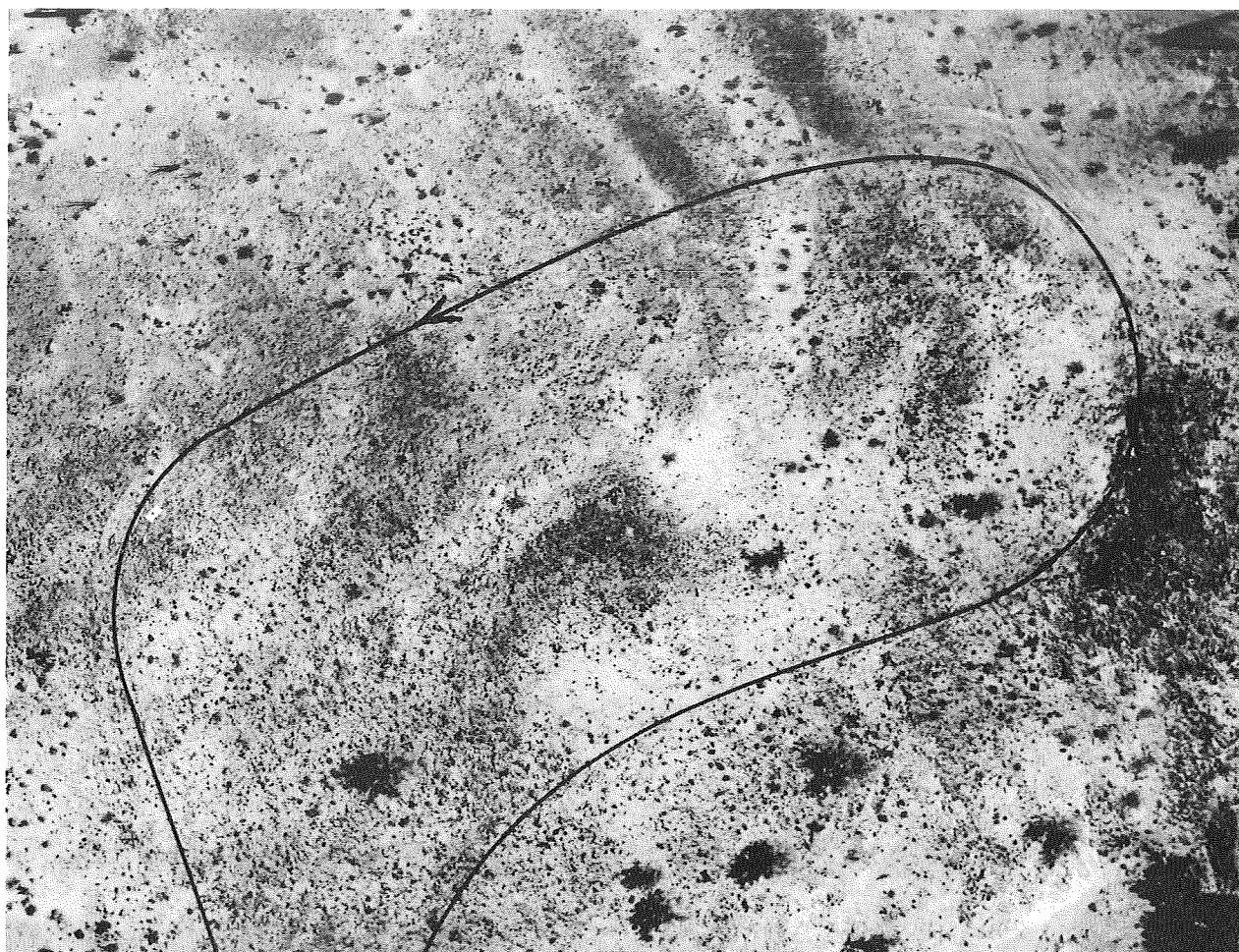


FIGURE 4. Clayton Hills, east loop, 500 feet.



FIGURE 5. Clayton Hills, 1000 feet.

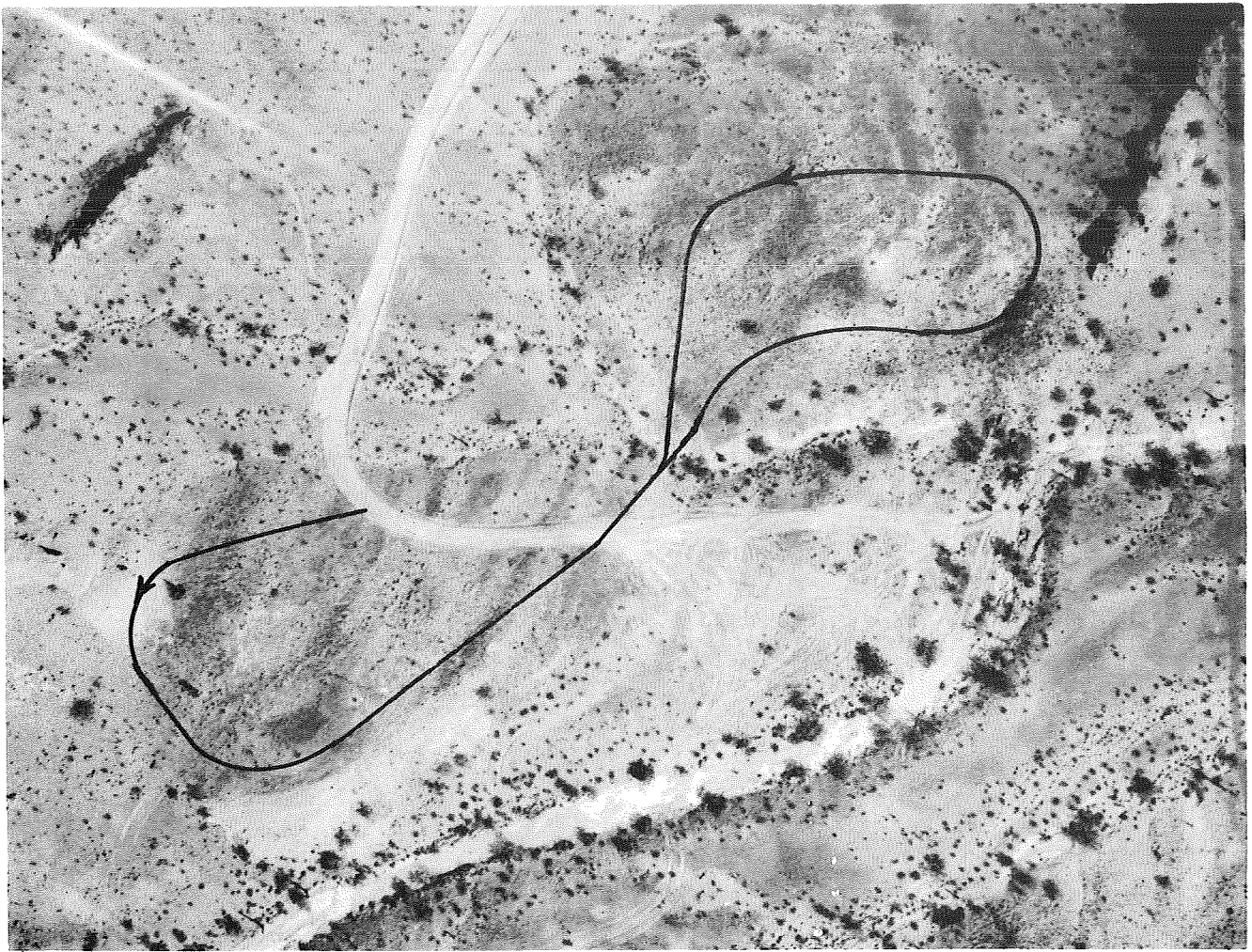


FIGURE 6. Clayton Hills, 1500 feet.

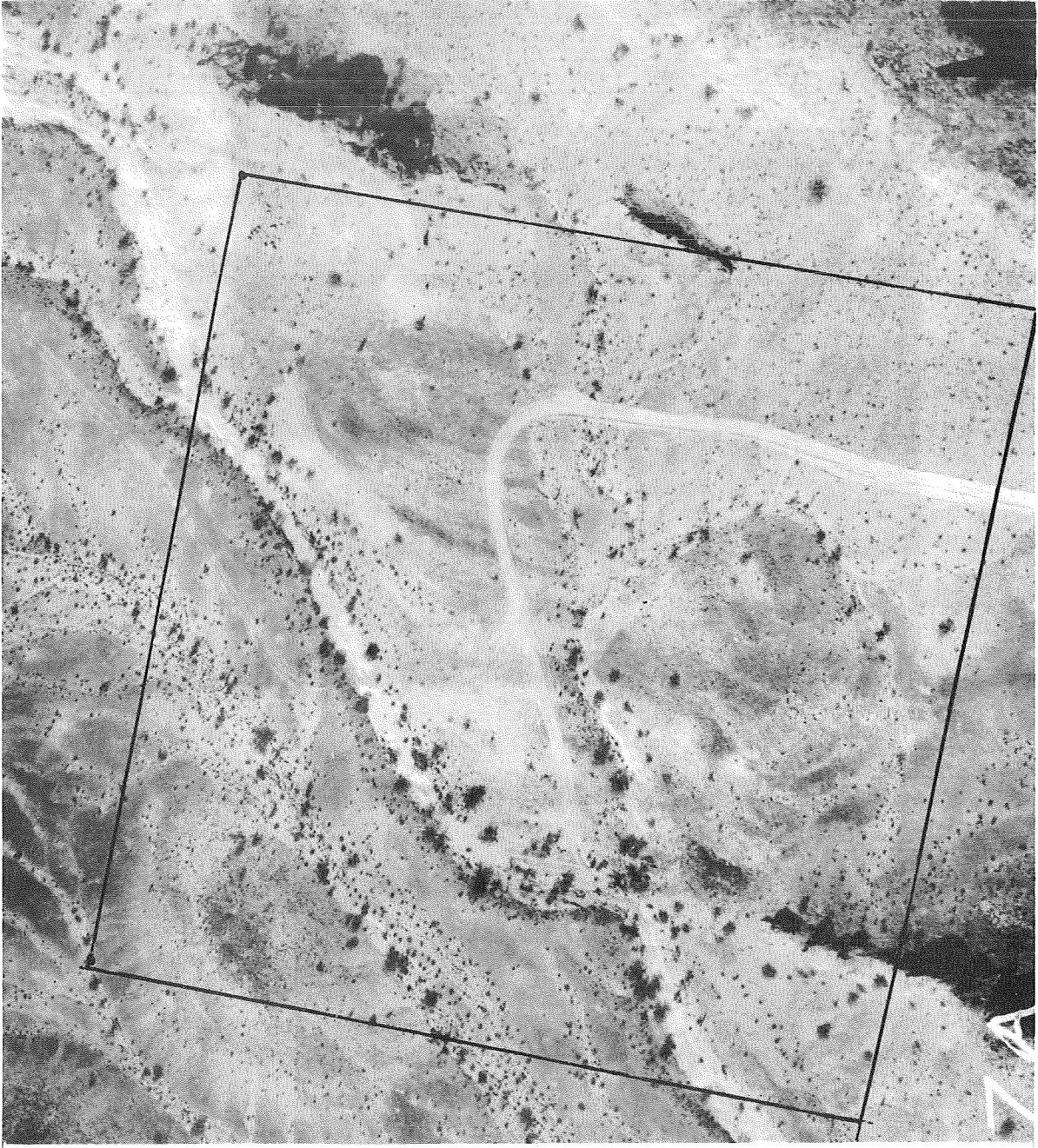


FIGURE 7. Clayton Hills, 2000 feet.

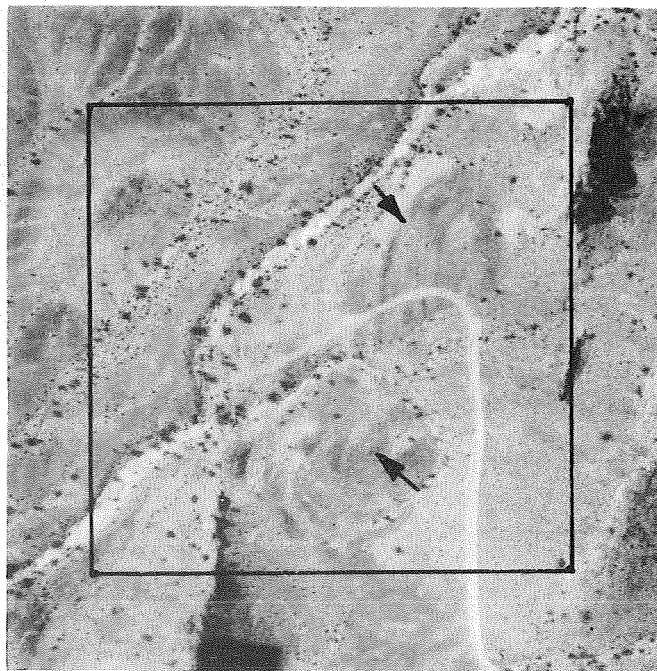
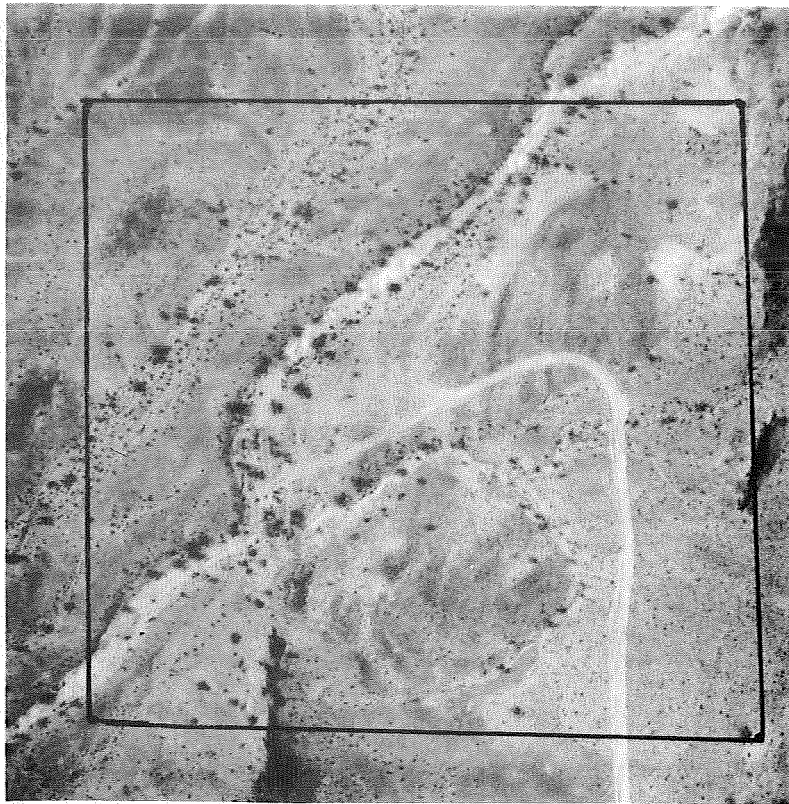


FIGURE 8. Clayton Hills. Top, 3000 feet; bottom, 4000 feet. Arrows point to white panels.

3.2 AERIAL PHOTOGRAPHS OF OTTER HILLY COURSE

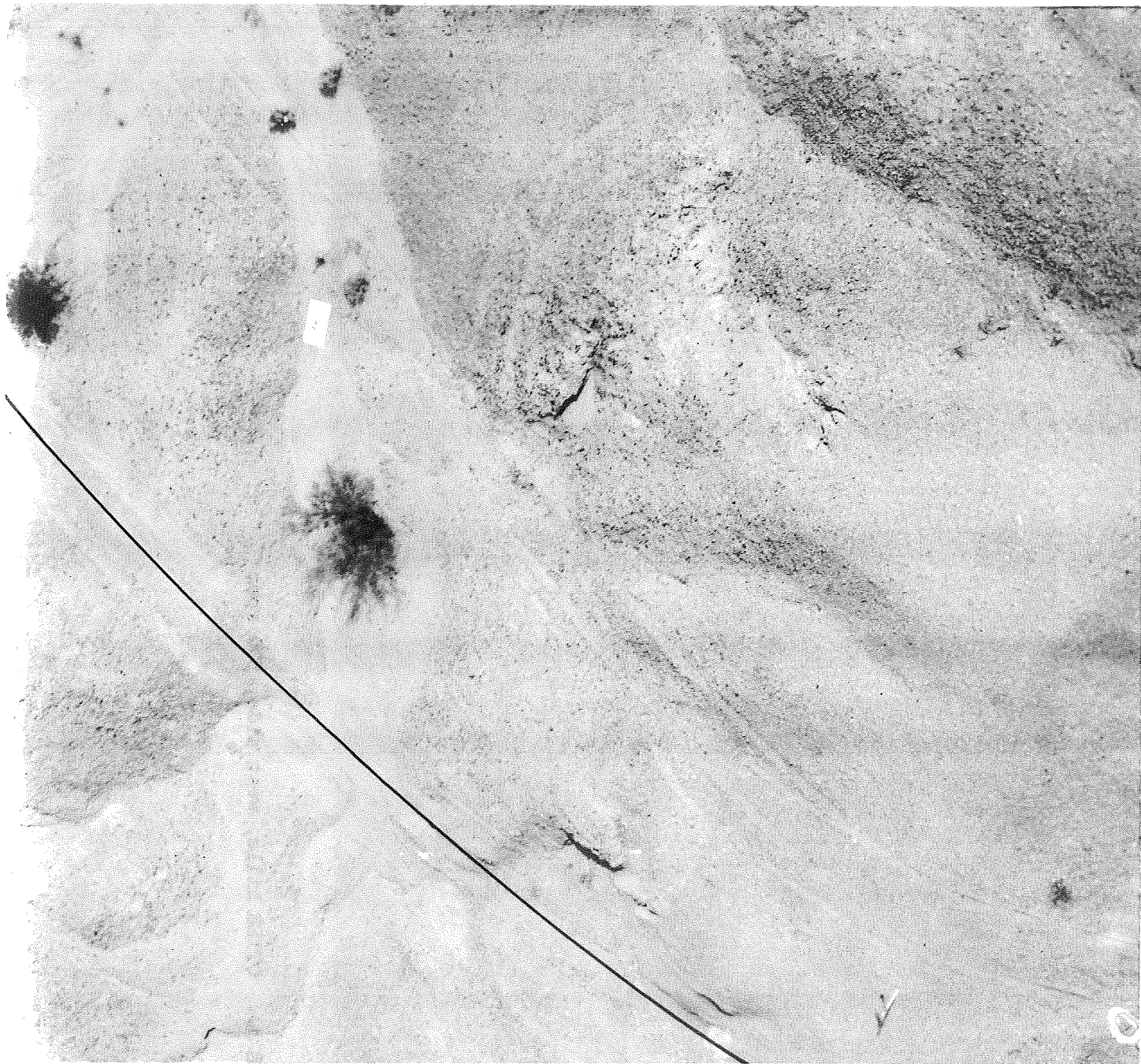


FIGURE 9. OTTER hills, west side, 200 feet.

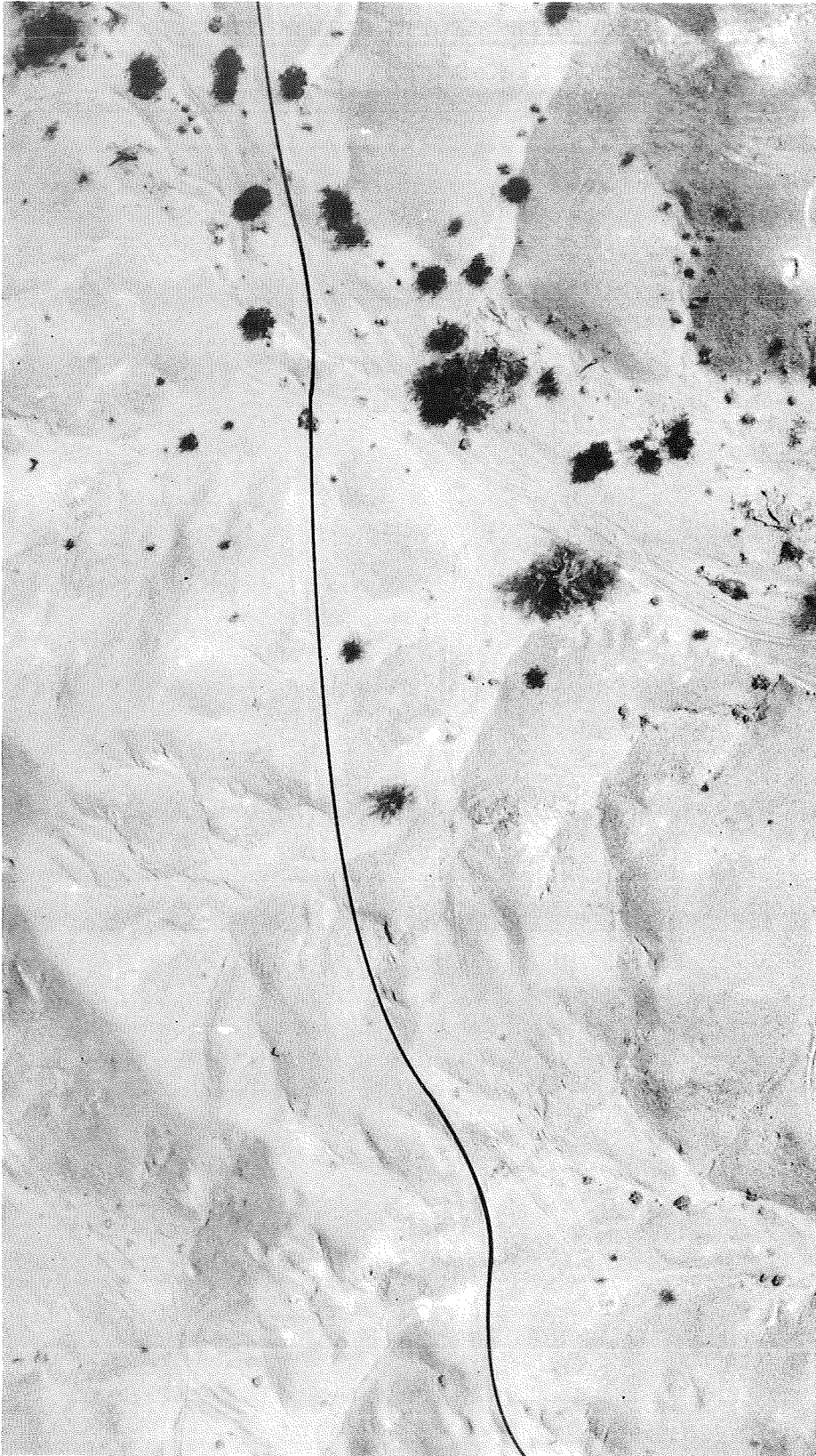


FIGURE 10. OTTER hills, west side, 500 feet

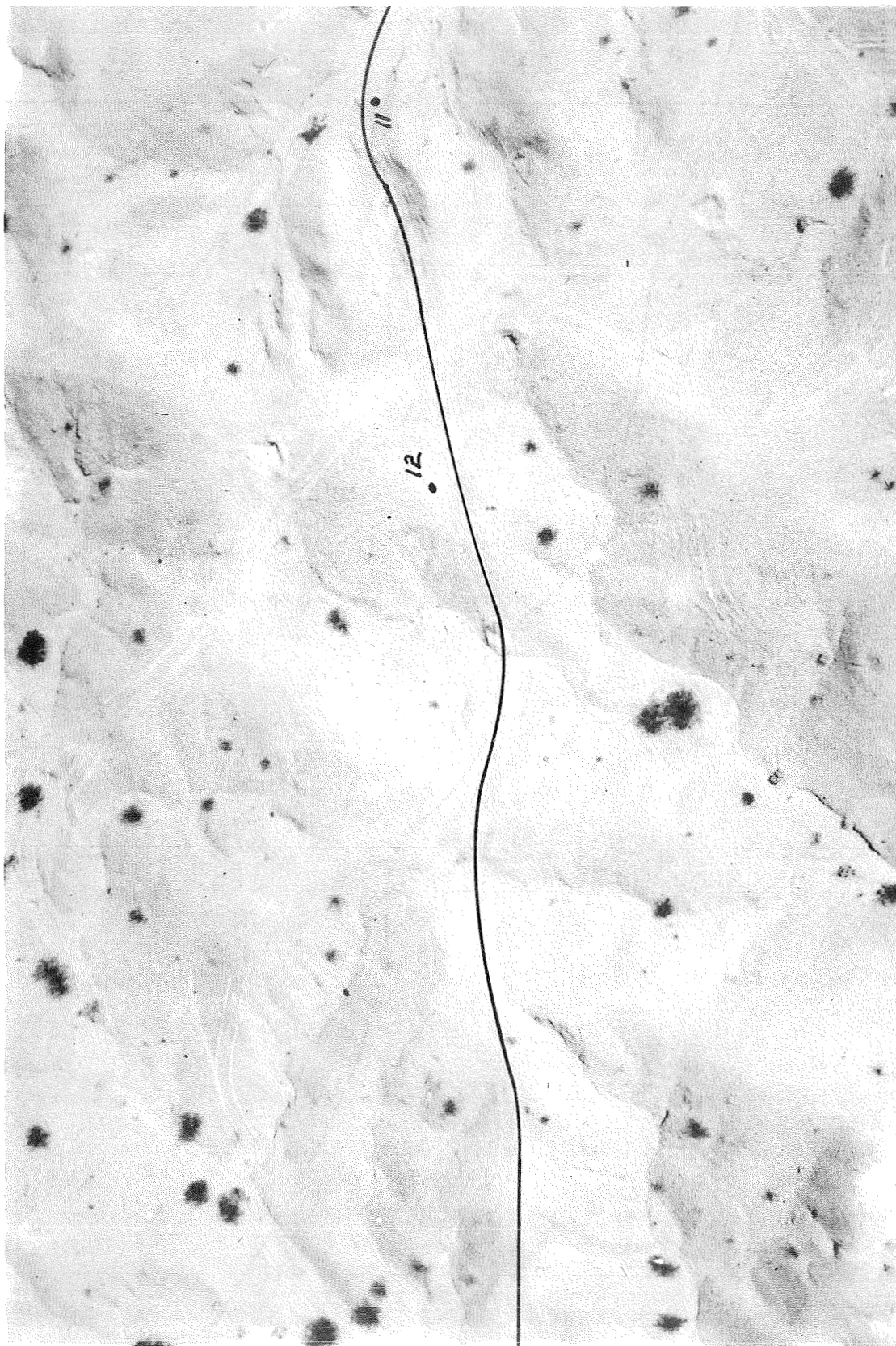


FIGURE 11. OTTER hills, east side, 500 feet.



FIGURE 12. OTTER hills, west side, 1000 feet.



FIGURE 13. OTTER hills, east side, 1000 feet.

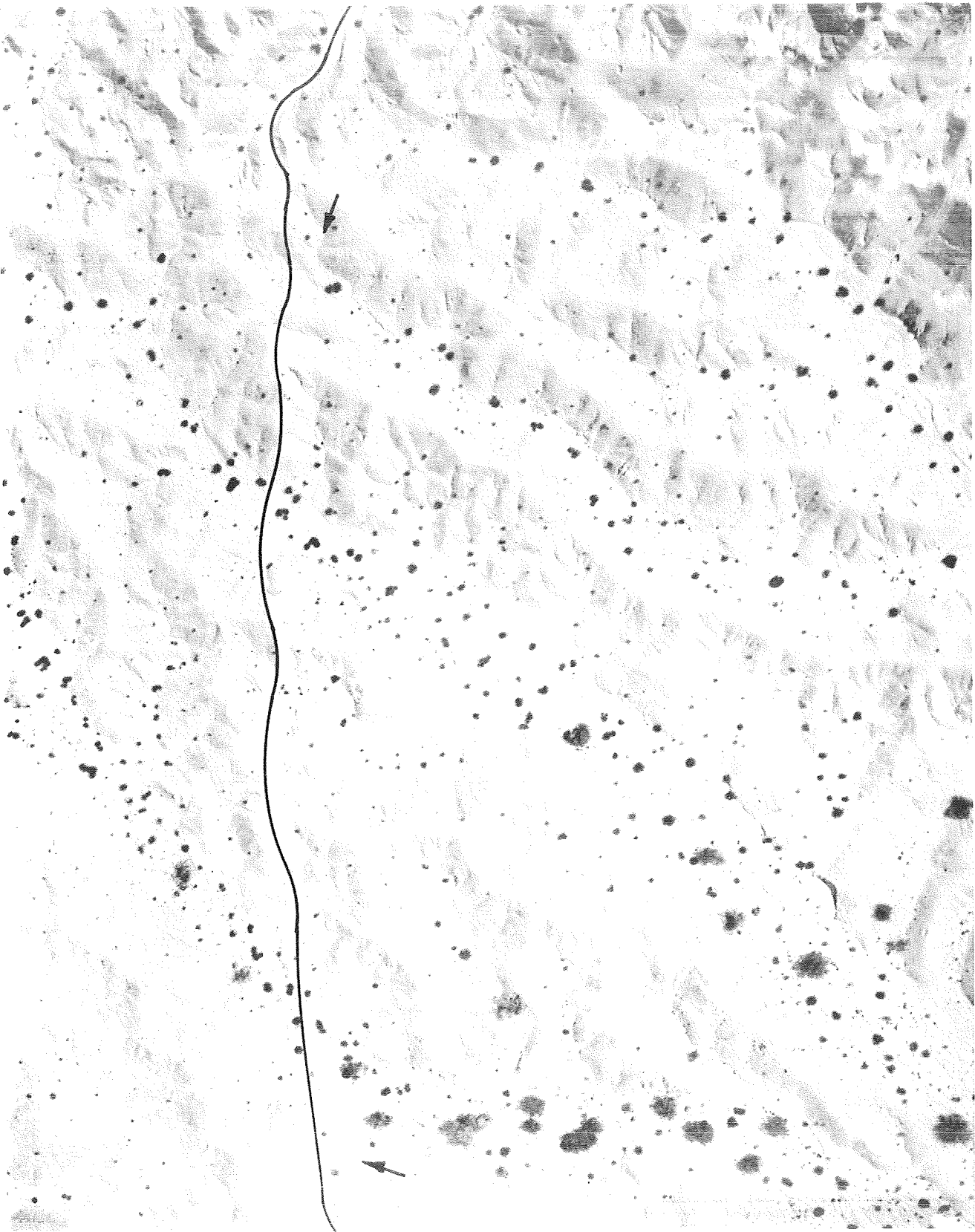


FIGURE 14. OTTER hills, 1500 feet. Arrows point to 2 by 4 foot white panels.



FIGURE 15. OTTER hills, 2000 feet.

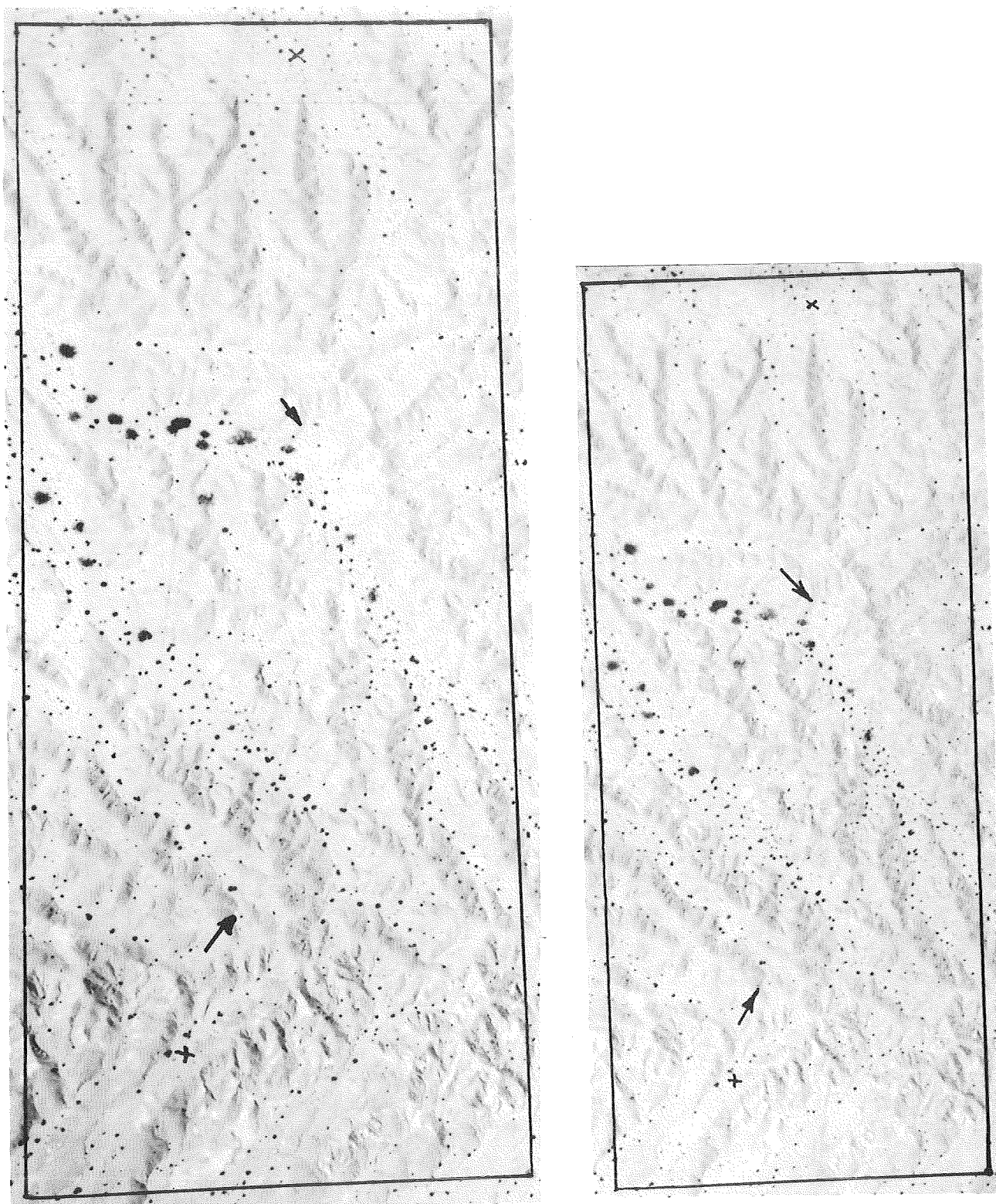


FIGURE 16. OTTER hills. Left, 3000 feet; right, 4000 feet.

3.3 PHOTOGRAPHS OF OTTER LEVEL COURSE

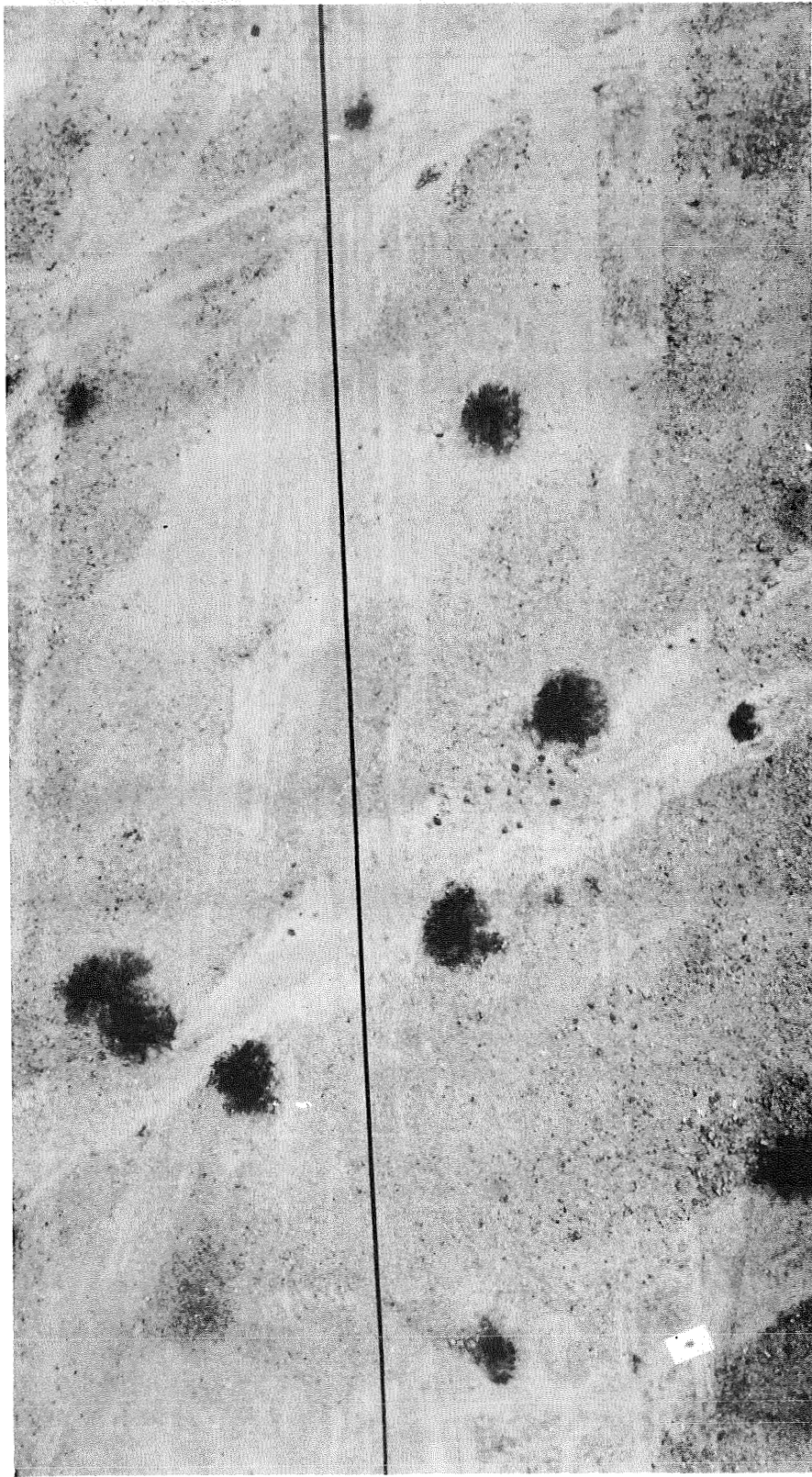


FIGURE 17. OTTER, level, 200 feet.

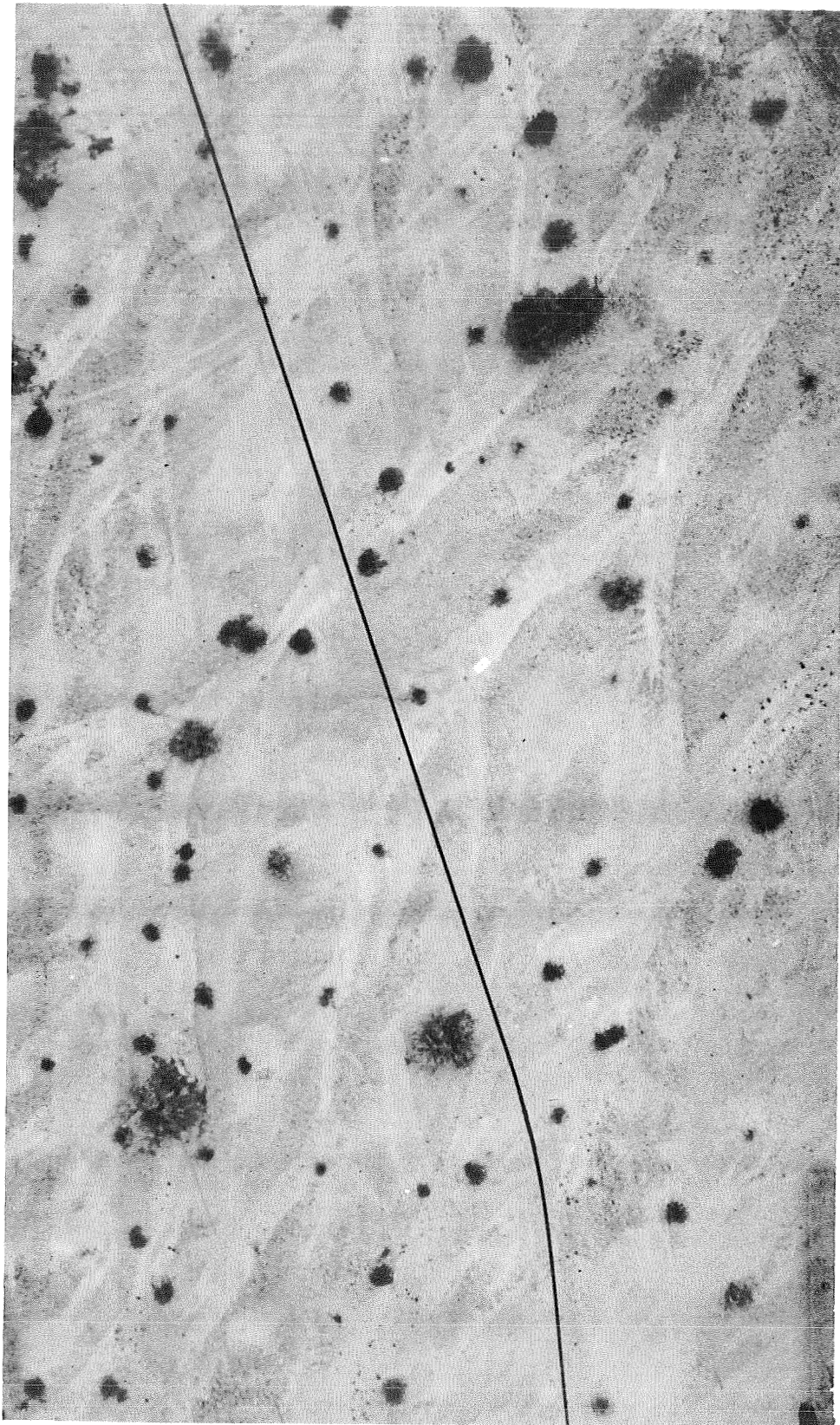


FIGURE 18. OTTER, level, 500 feet.

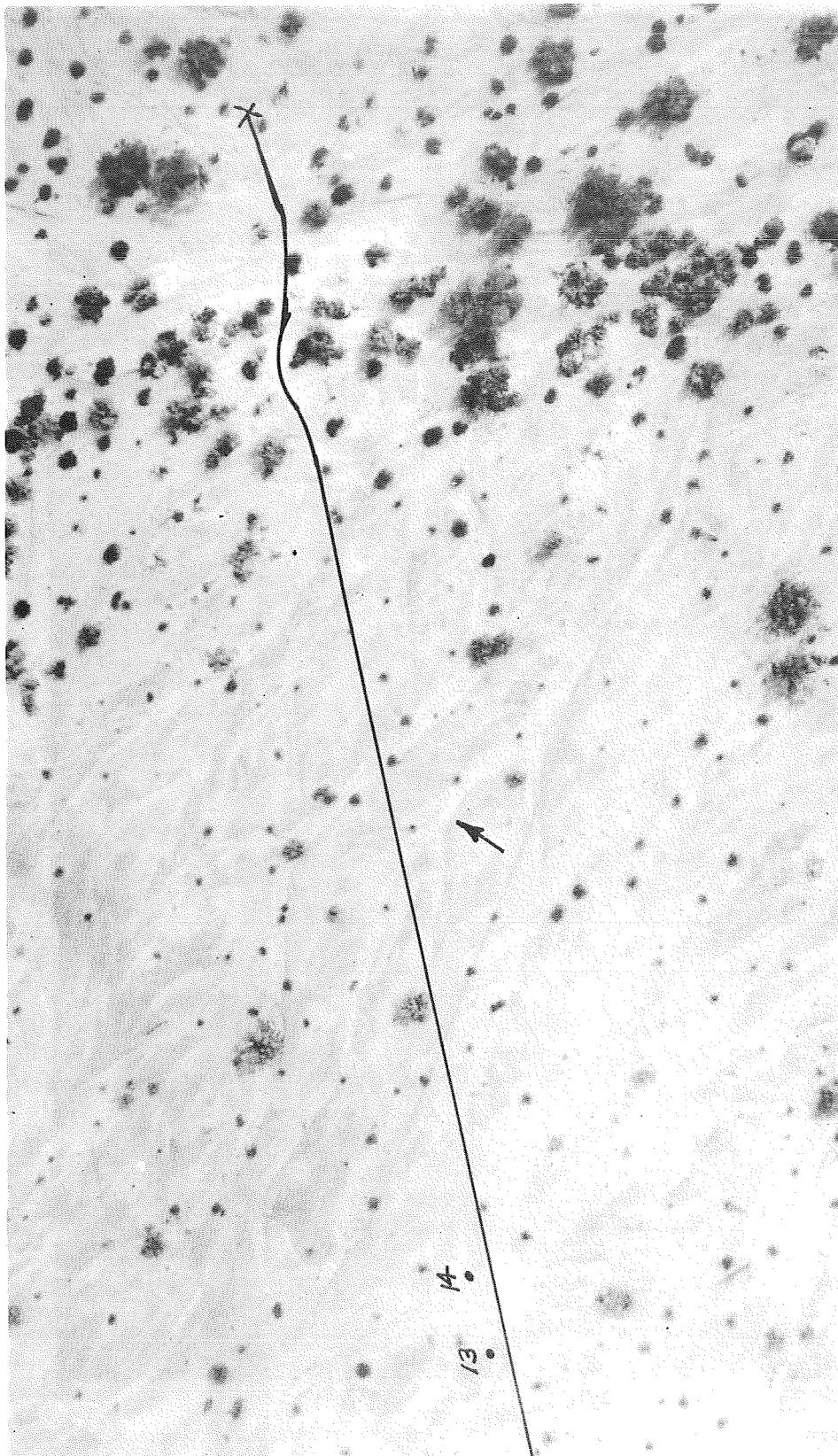


FIGURE 19. OTTER, level, 1000 feet

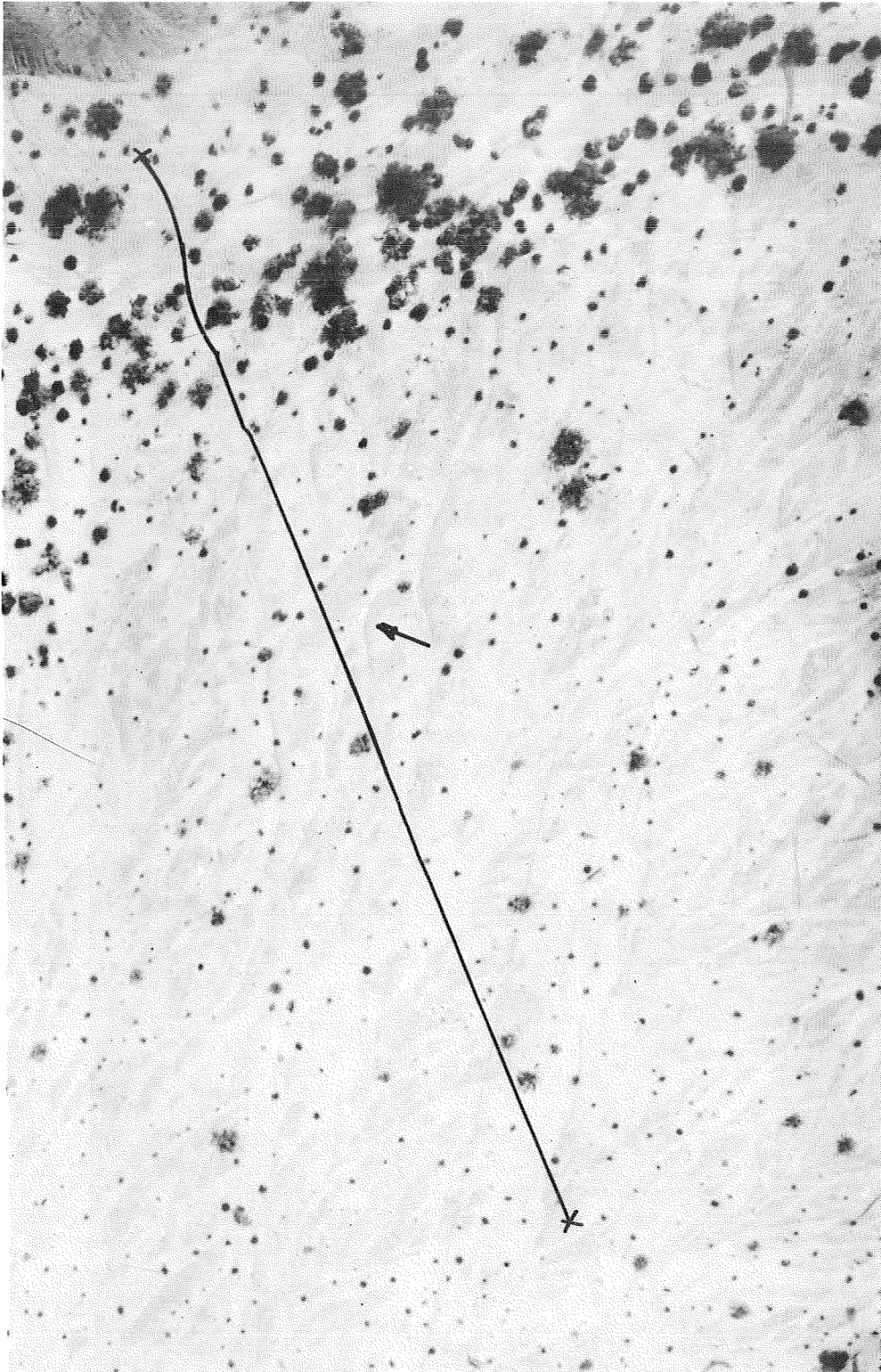


FIGURE 20. OTTER, level, 1500 feet.

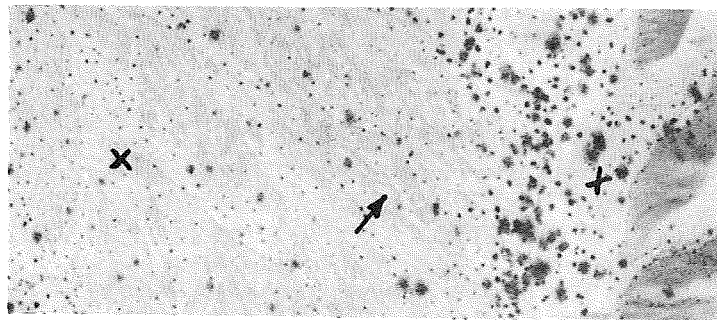
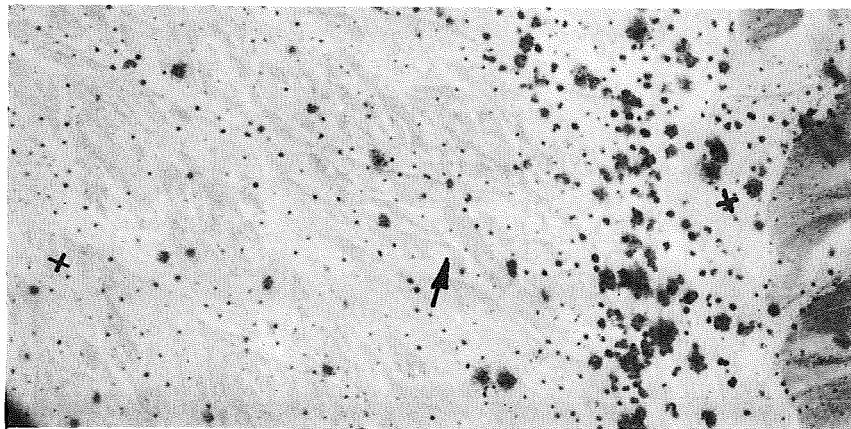
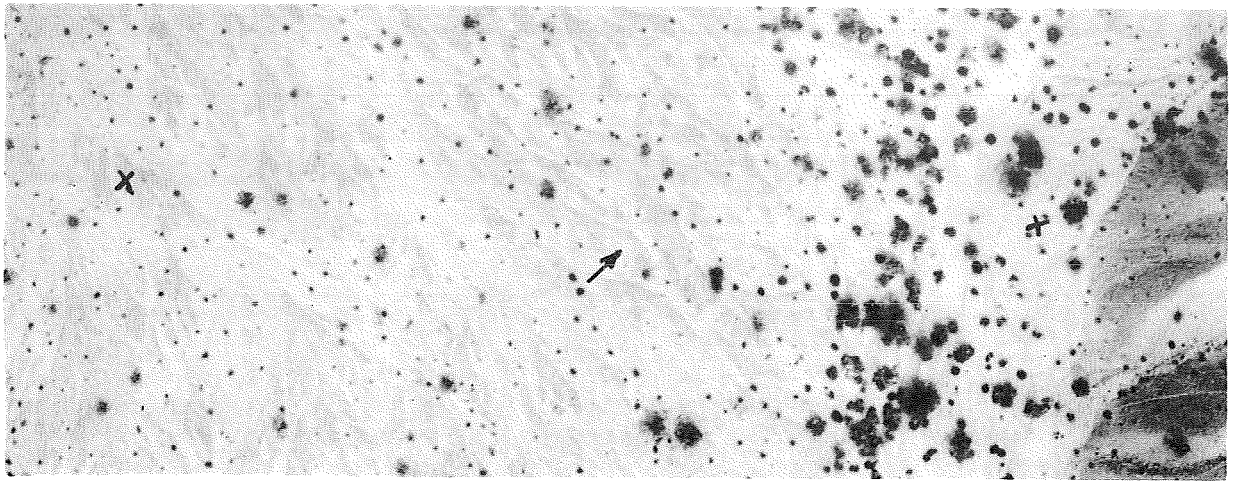


FIGURE 21. OTTER level course. Top, 2000 feet; center, 3000 feet; bottom, 4000 feet.

3.4 DESCRIPTION AND PARTICLE SIZE ANALYSIS,
CLAYTON HILLS AND OTTER COURSES

Location No.	Geological Description	Particle Size Distribution					No. of Particles
		Particle Size (in.)	(cm)	Weight (lb)	(kg)	Percent Retained*	
1	Loose angular rhyolite rock frag- ments mixed with loose weathered volcanic dike de- bris from 1-3 in. in diameter.	3	7.6	14	6.4	20.4	6
		1-1/2	3.8	28	12.7	40.9	93
		1-1/4	3.2	10	4.5	14.6	87
		7/8	2.2	16.5	7.5	24.1	Numerous
2	Same as No. 1 ex- cept the rhyolite is up to 12 in.	12	30.5	28	12.7	20.5	1
		6	15.2	6.5	3.0	4.7	1
		4	10.1	27	12.3	19.8	14
		3	7.6	32	14.5	23.5	13
		1-1/2	3.8	30	13.6	22.0	88
		1-1/4	3.2	5	2.3	3.7	39
		7/8	2.2	8	3.6	5.8	87
3	Very weathered vol- canic dike debris with inclusions of parent rock (with loose surface).	3	7.6	3.5	1.6	50.0	1
		1-1/2	3.8	1	0.5	14.3	5
		1-1/4	3.2	1	0.5	14.3	11
		7/8	2.2	1.5	0.7	21.4	42
4	Loose weathered volcanic dike debris with angu- lar rhyolite rock and gravel frag- ments.	6	15.2	7.5	3.4	11.2	1
		5	12.7	5	2.3	7.5	2
		4	10.1	4	1.8	6.0	2
		3	7.6	3.5	1.6	5.2	4
		1-1/2	3.8	29	13.2	43.3	89
		1-1/4	3.2	7	3.2	10.4	79
		7/8	2.2	11	5.0	16.4	Numerous
5	Weathered volcanic dike with large in- clusions of parent rock still in place with large angular boulders of rhyo- lite approximately two cubic feet in size.	16	40.6	Em- bed- ded	-	-	1
		6	15.2	16.5	7.5	20.1	2
		5	12.7	35	16.0	42.7	6
		4	10.1	11	5.0	13.4	4
		3	7.6	7.5	3.4	9.2	8
		1-1/2	3.8	8	3.6	9.8	22
		1-1/4	3.2	2	0.9	2.4	15
		7/8	2.2	2	0.9	2.4	47

*By weight

Location No.	Geological Description	Particle Size Distribution					
		Particle Size (in.)	Particle Size (cm)	Weight (lb) (kg)		Percent Retained*	No. of Particles
6	Loose weathered dike with boulders of rhyolite up to 10 inches in diameter.	10	25.4	27	12.3	35.5	1
		6	15.2	12	5.4	15.8	1
		5	12.7	12	5.4	15.8	2
		3	7.6	4	1.8	5.3	4
		1-1/2	3.8	14.5	6.6	19.1	61
		1-1/4	3.2	2	0.9	2.6	26
		7/8	2.2	4.5	2.0	5.9	76
7	Volcanic extrusion, very weathered, with loose scoria up to 6 in. in diameter	6	15.2	13	5.9	12.9	1
		4	10.1	8	3.6	7.9	2
		3	7.6	16	7.3	15.8	9
		1-1/2	3.8	50	22.7	49.5	143
		1-1/4	3.2	6	2.7	5.9	29
		7/8	2.2	8	3.6	8.0	63
8	Weathered volcanic dike material with loose angular rhyolite fragments up to 5 in. in diameter.	5	12.7	17	7.7	29.8	2
		4	10.1	6	2.7	10.5	1
		3	7.6	3	1.4	5.3	11
		1-1/2	3.8	19	8.6	33.3	43
		1-1/4	3.2	4	1.8	7.1	17
		7/8	2.2	8	3.6	14.0	100
9	Same as No. 8 except with angular fragments up to 10 in. in diameter.	10	25.4	14	6.4	20.9	1
		6	15.2	22	10.0	32.8	2
		4	10.1	13	5.9	19.4	5
		3	7.6	3	1.4	4.5	4
		1-1/2	3.8	12	5.4	17.9	55
		1-1/4	3.2	2	0.9	3.0	31
		7/8	2.2	1	0.5	1.5	86
10	Same as No. 8 except angular rhyolite fragments mixed with scoria up to three or four in. in diameter.	4	10.1	6	2.7	30.0	4
		3	7.6	3	1.4	15.0	4
		1-1/2	3.8	9	4.1	45.0	40
		1-1/4	3.2	1	0.5	5.0	20
		7/8	2.2	1	0.5	5.0	84

*By weight

Location No.	Geological Description	Particle Size Distribution					No. of Particles
		Particle Size (in.)	Size (cm)	Weight (lb) (kg)		Percent Retained*	
Hilly							
11	Loose angular	3	7.6	-	-	-	-
	rhyolite rock frag-	1-1/2	3.8	12.5	5.7	44.6	24
	ments from pea	1-1/4	3.2	6	2.7	21.4	21
	gravel to 1-1/2	7/8	2.2	9.5	4.3	34.0	100
	inches in diameter.						
12	Same as No. 11 ex-	3	7.6	-	-	-	-
	cept fragments to	1-1/2	3.8	-	-	-	-
	1-1/4 inches in	1-1/4	3.2	1.5	.7	42.9	10
	diameter.	7/8	2.2	2	.9	57.1	38
Level							
13	Loose angular	5	12.7	14	6.3	6.3	1
	rhyolite and desert	4	10.2	19	8.6	29.9	7
	rock from pea grav-	3	7.6	5	2.3	7.9	4
	el to 5 inches in	1-1/2	3.8	30	13.6	47.2	90
	diameter	1-1/4	3.2	1.5	.7	2.4	34
		7/8	2.2	4	1.8	6.3	97
14	Small rhyolitic	3	7.6	-	-	-	-
	and quartz rocks	1-1/2	3.8	0.5	.2	100.0	3
	from grains to	1-1/4	3.2	Nil	-	Nil	2
	1-1/2 inches in	7/8	2.2	Nil	-	Nil	11
	diameter.						

*By weight

NOTE: Locations 1 through 10, Clayton Hills Course; 11 through 14, OTTER Courses



FIGURE 21. Sample No. 1 from Clayton Hills. See Figure 5, Appendix 3.1, for location of sample on course. (Photograph of Sample No. 2 not available.)

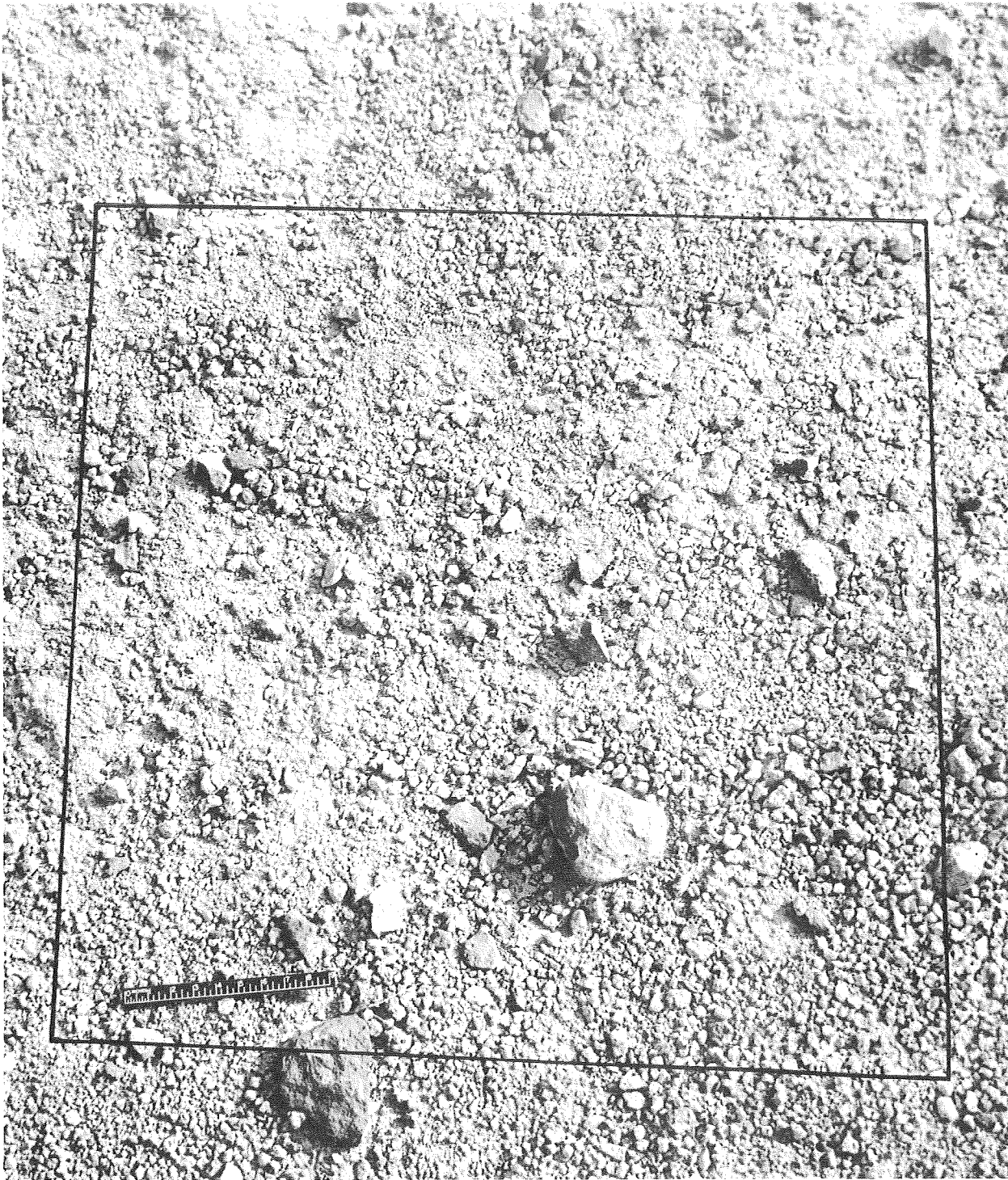


FIGURE 22. Sample No. 3 from Clayton Hills. See Figure 5, Appendix 3.1, for location of sample on course.

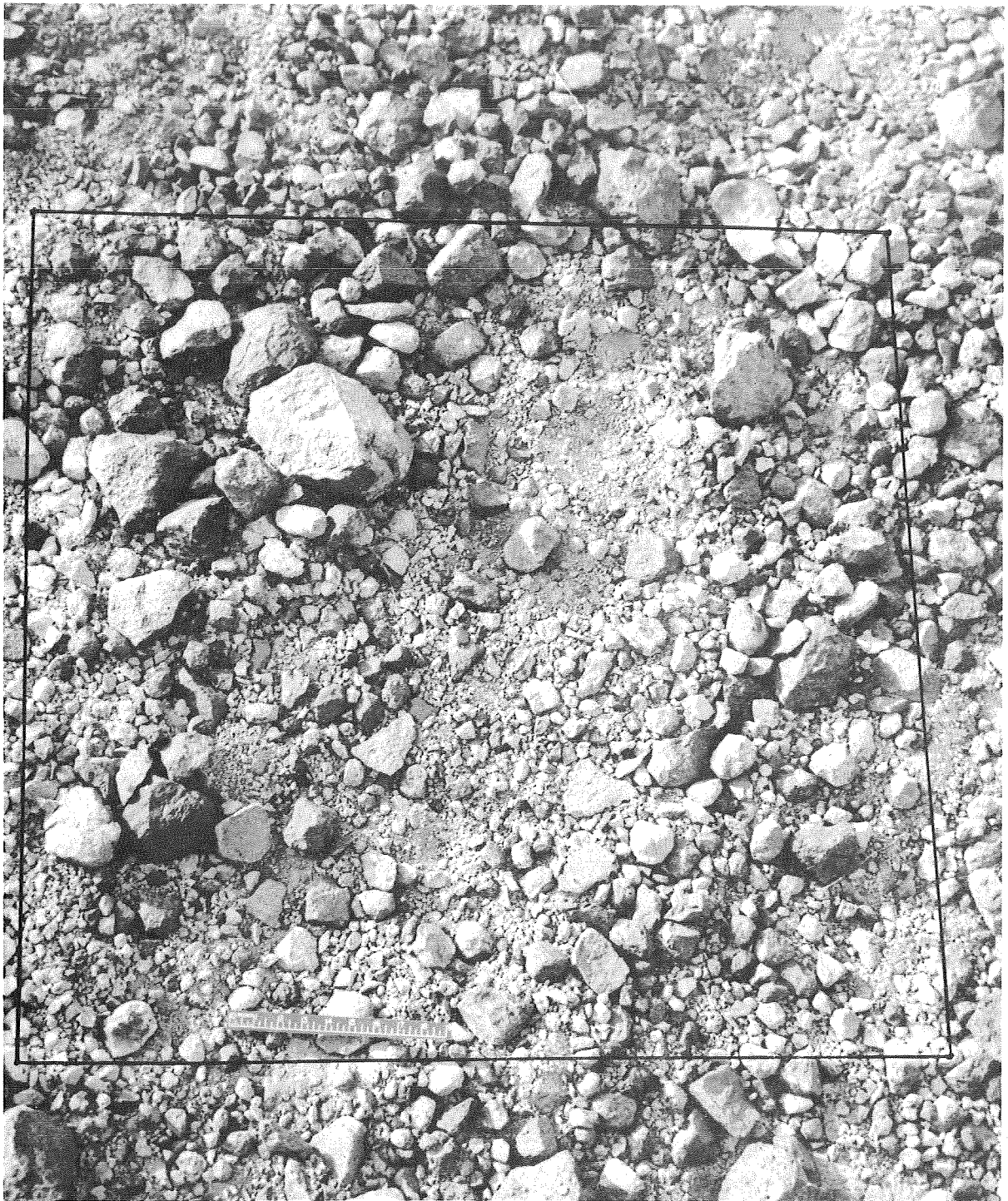


FIGURE 23. Sample No. 4 from Clayton Hills. See Figure 5, Appendix 3.1, for location of sample on course.

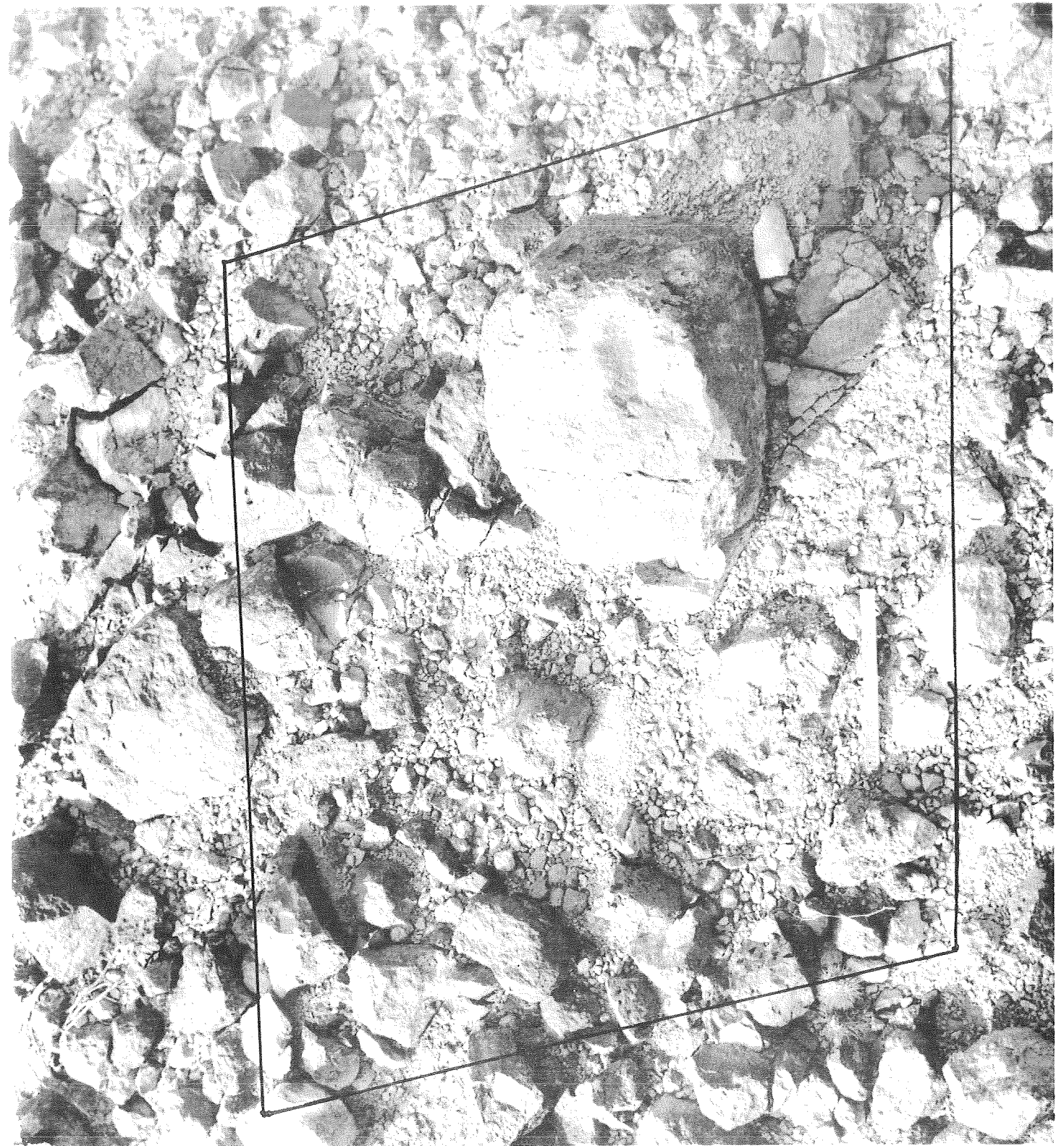


FIGURE 24. Sample No. 5 from Clayton Hills. See Figure 5, Appendix 3.1, for location of sample on course.



FIGURE 25. Sample No. 6 from Clayton Hills. See Figure 5, Appendix 3.1, for location of sample on course.



FIGURE 26. Sample No. 7 from Clayton Hills. See Figure 5, Appendix 3.1, for location of sample on course.



FIGURE 27. Sample No. 8 from Clayton Hills. See Figure 5, Appendix 3.1, for location of sample on course.



FIGURE 28. Sample No. 9 from Clayton Hills. See Figure 5, Appendix 3.1, for location of sample on course.



FIGURE 29. Sample No. 10 from Clayton Hills. See Figure 5, Appendix 3.1, for location of sample on course.



FIGURE 30. Sample No. 11 from OTTER Hilly Course. See Figure 11, Appendix 3.2 location of sample on course.

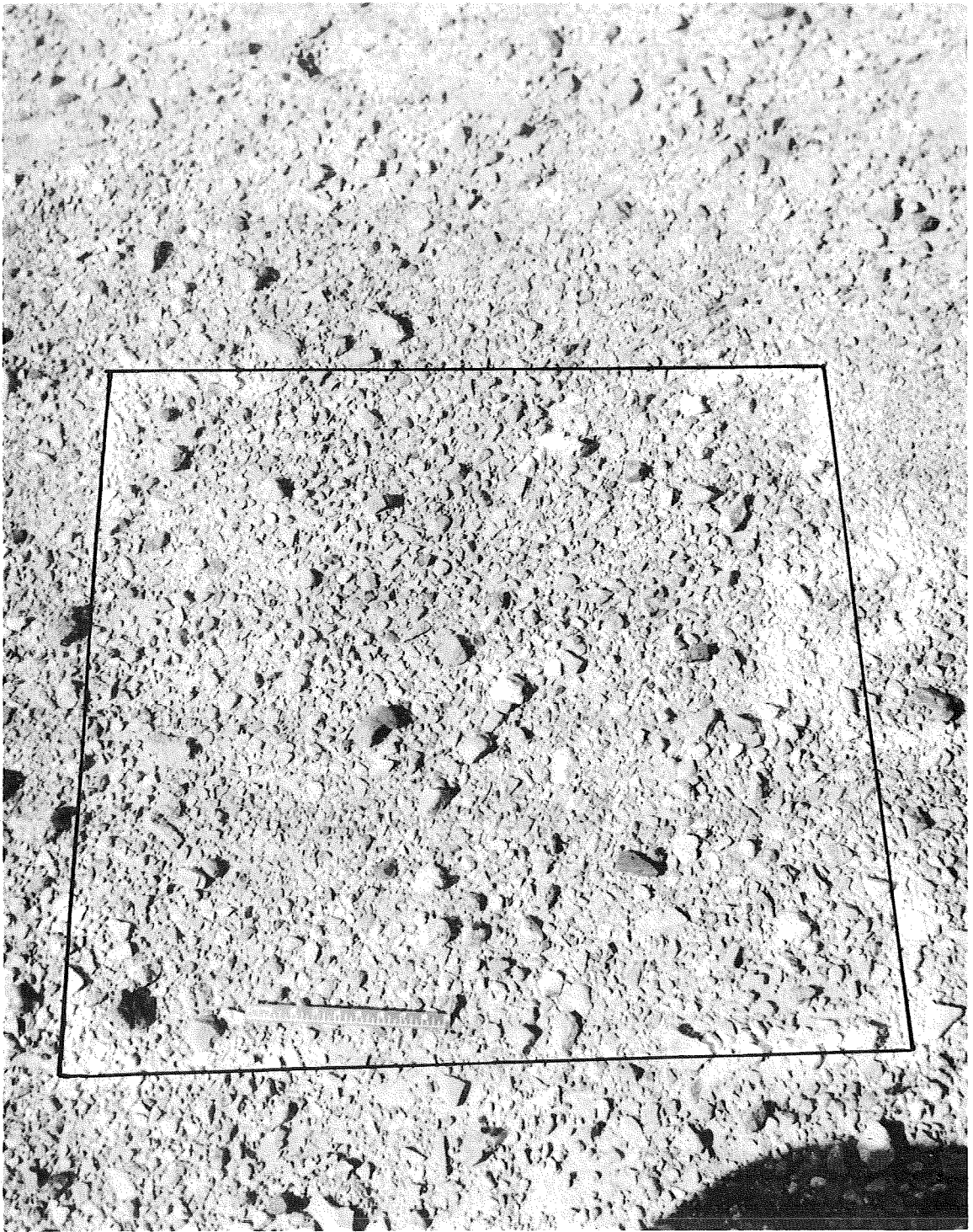


FIGURE 31. Sample No. 12 from OTTER Hilly Course. See Figure .11, Appendix 3.2, for location of sample on course.

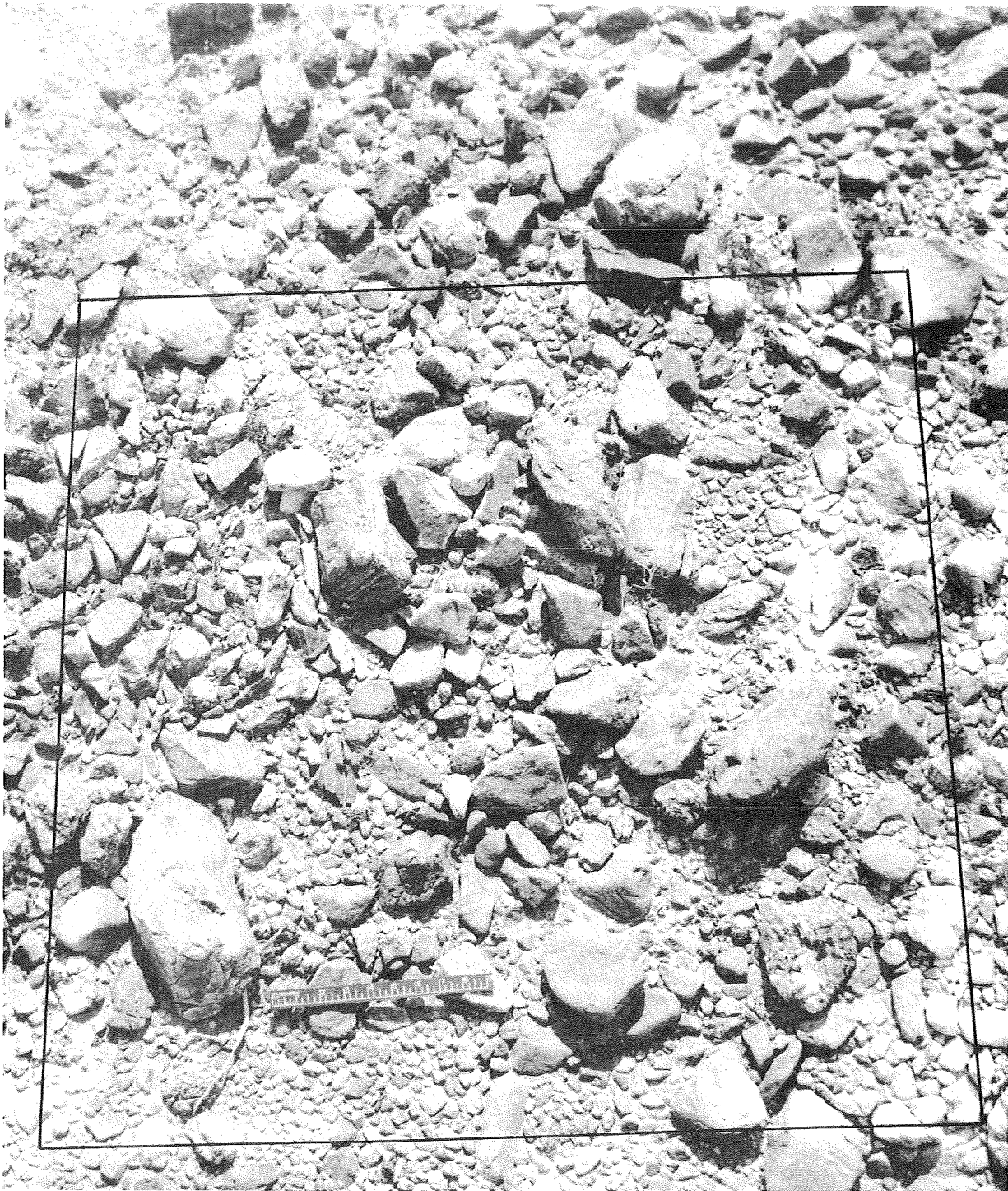


FIGURE 32. Sample No. 13 from OTTER Level Course. See Figure 19, Appendix 3.3, for location of sample on course.

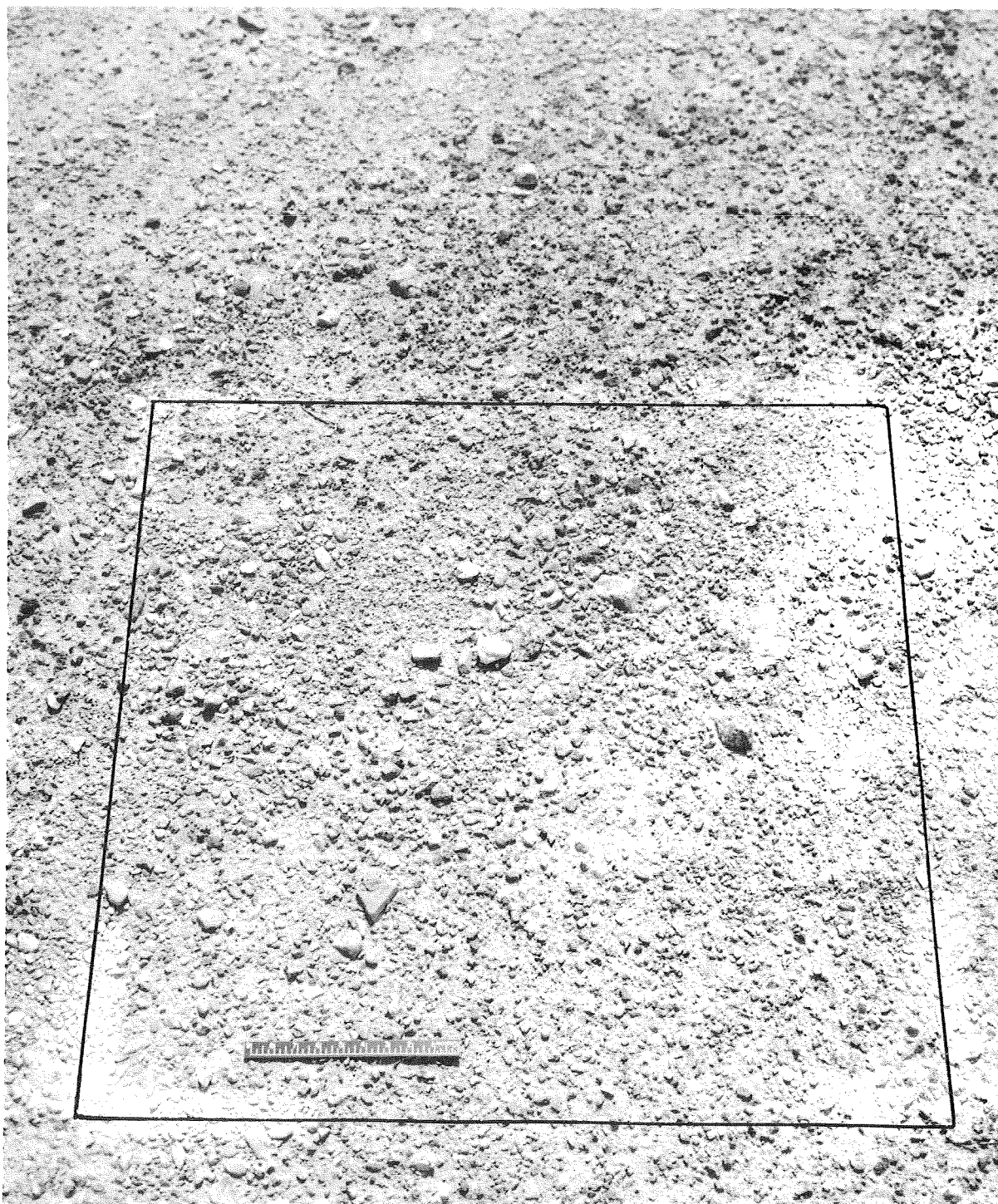


Figure 33. Sample No. 14 from OTTER Level Course. See Figure 19, Appendix 3.3, for location of sample on course.

3.6 PROFILE OF CLAYTON HILLS

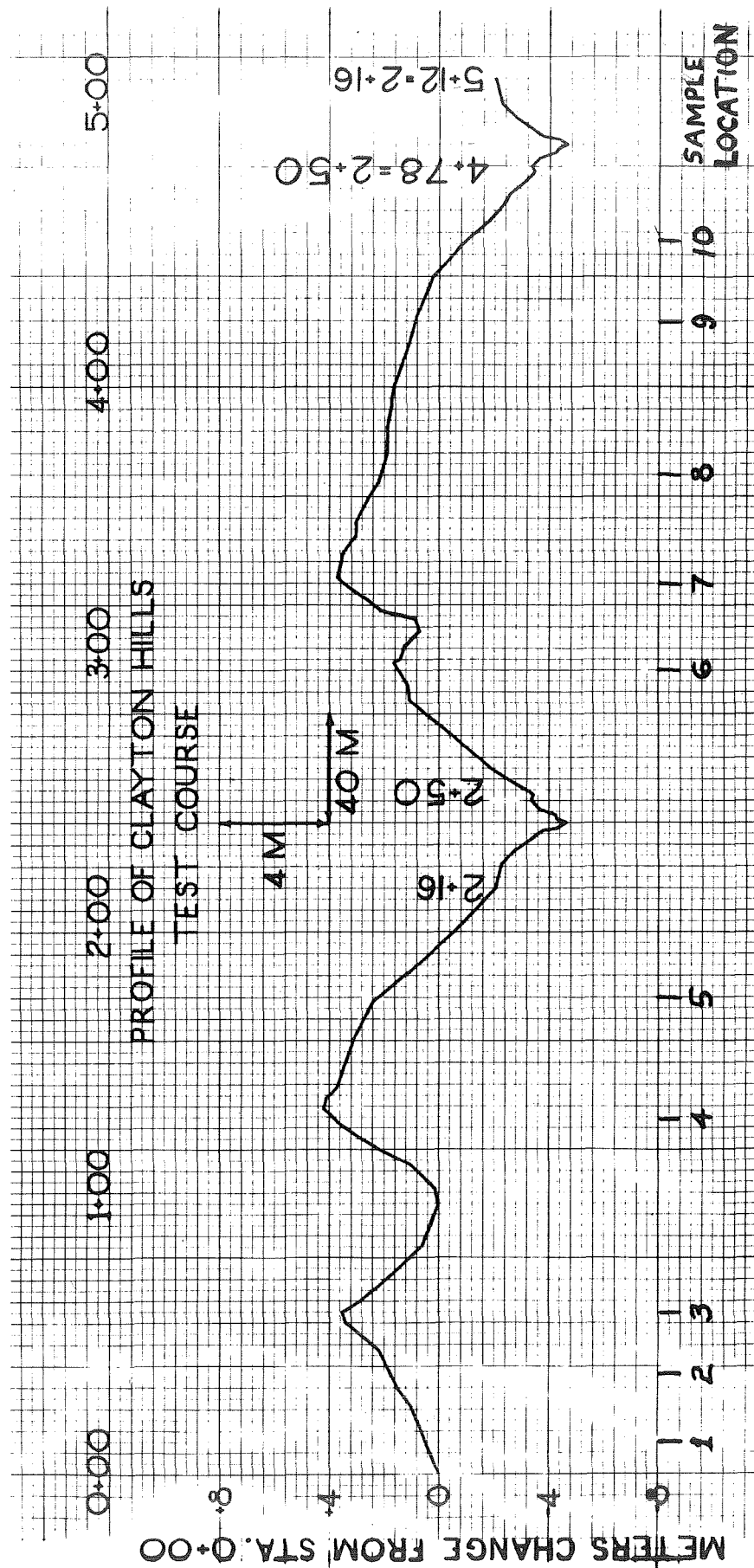


FIGURE 34. Clayton Hills profile; east loop. 0+00 to 2+16; west loop 2+16 to 5+12.



FIGURE 35. Lava and large rock course. Note figure in center.



FIGURE 36. Lava and large rock course. Note figure in center.

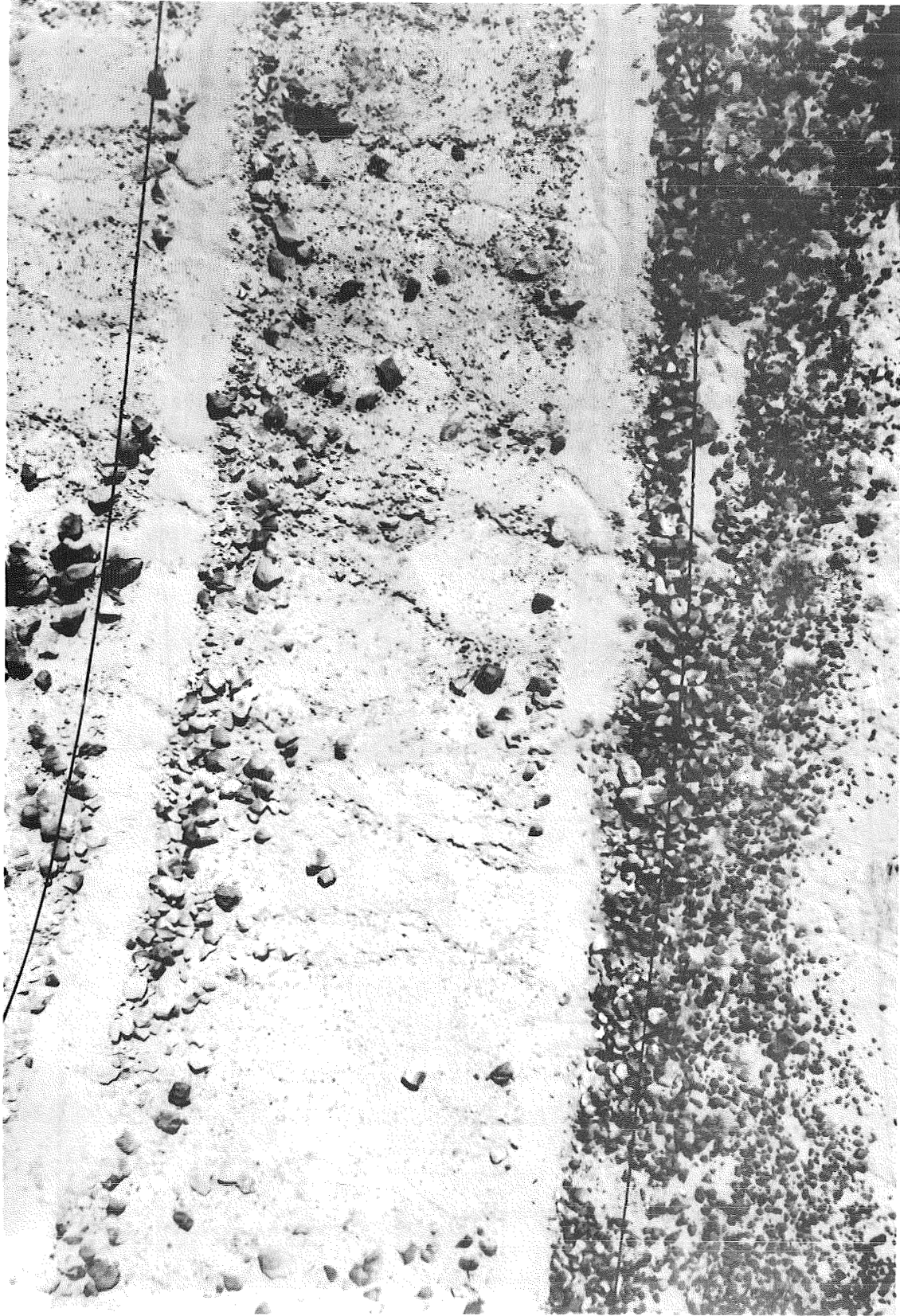


FIGURE 37. Ogilby Hill Rock Course, 200 feet; white panel is on lower "road", left center of photograph.

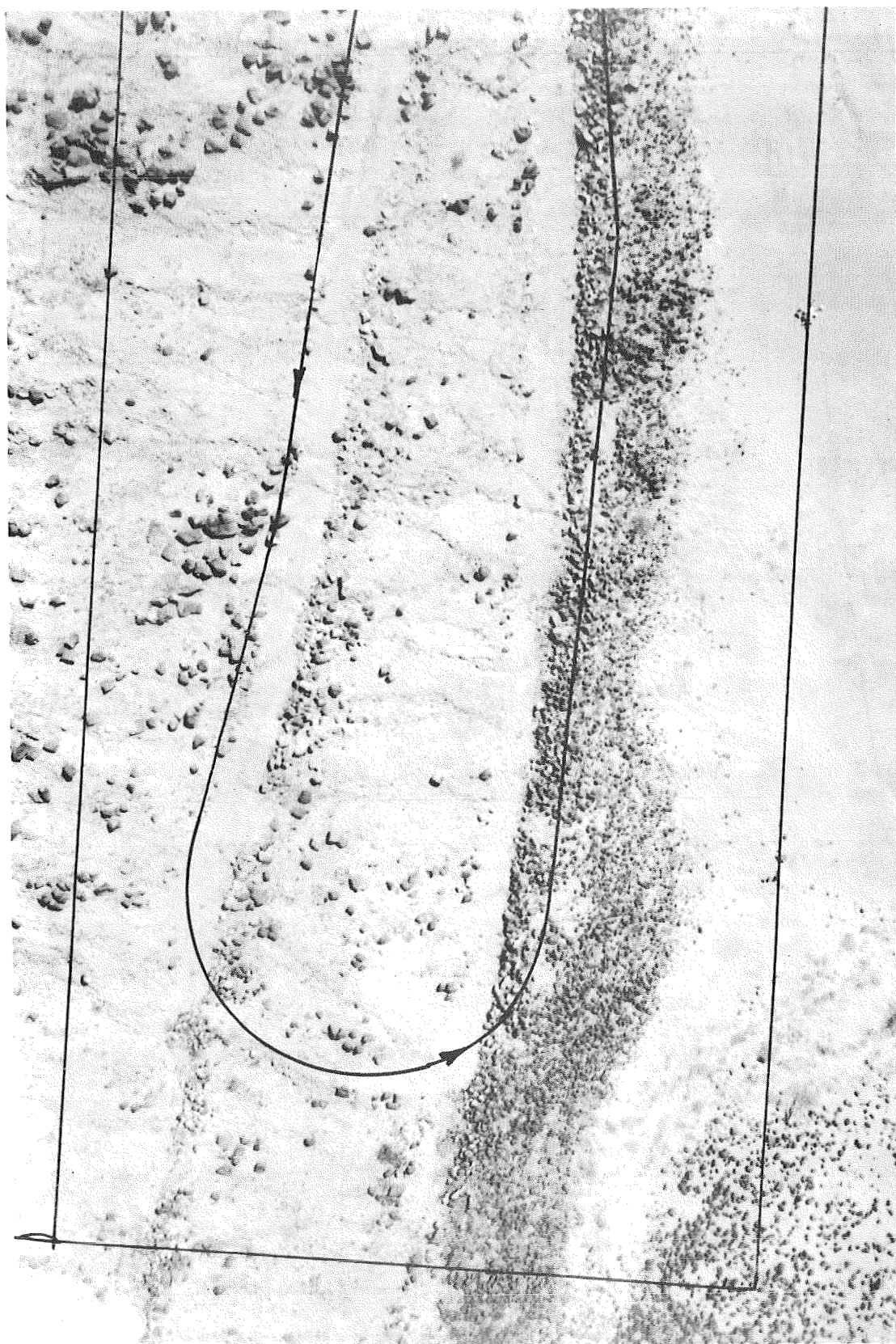


FIGURE 38 Ogilby Hill Rock Course, 500 feet.

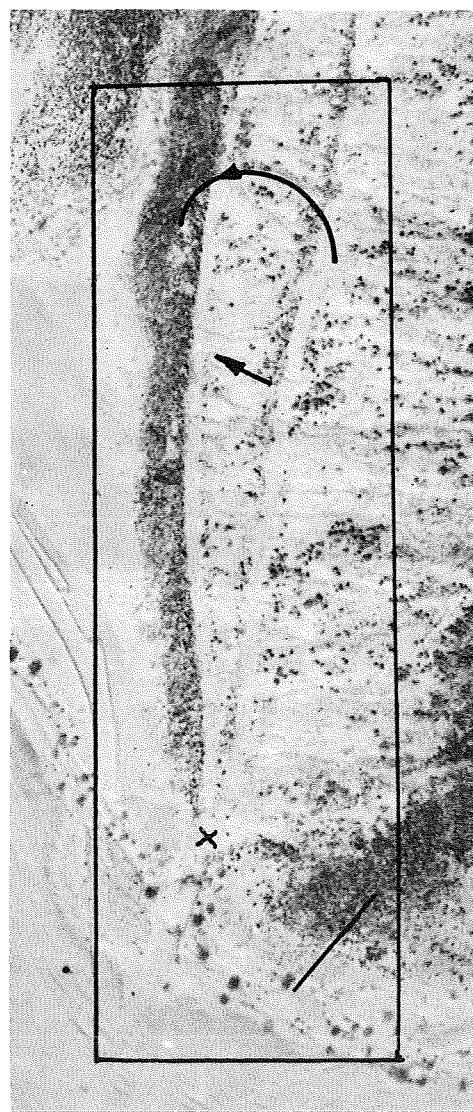
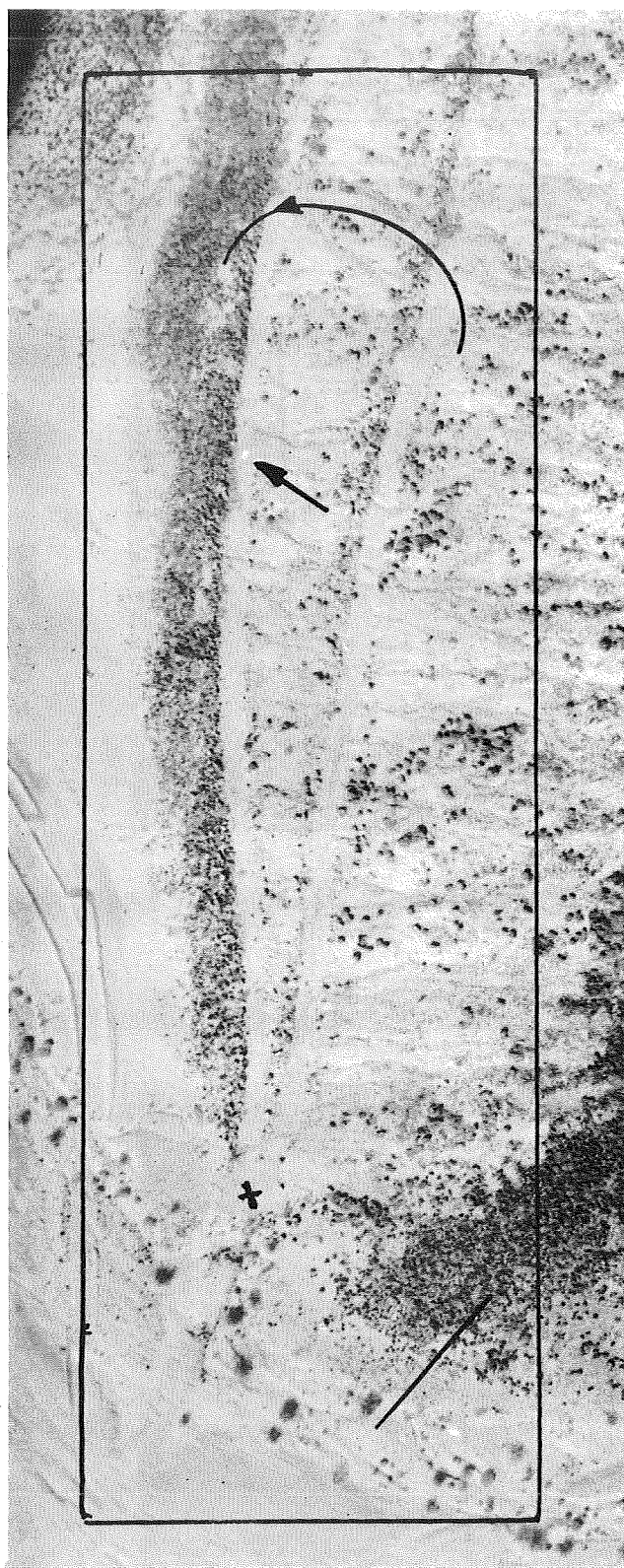


FIGURE 39. Ogilby Hill Rock Course. Left, 1000 feet; right 1500 feet. Circular arrow shows route of turn. Arrow points to 2 by 4 foot panel. Straight line is on 32 percent slope. X is start and end of course.

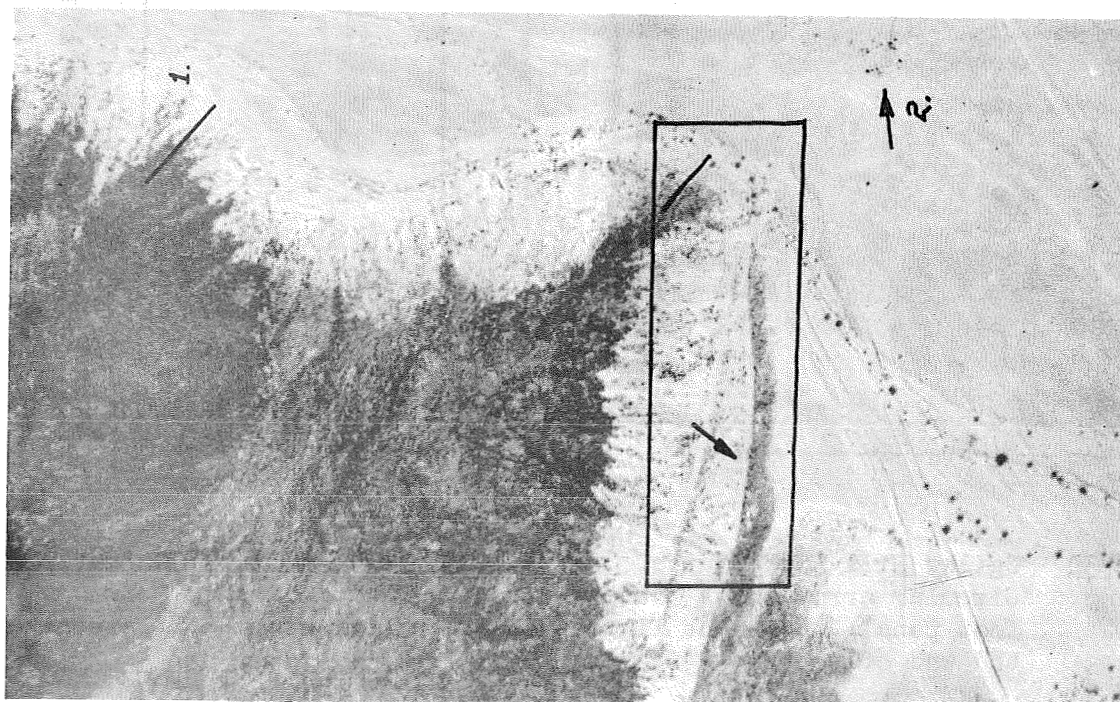
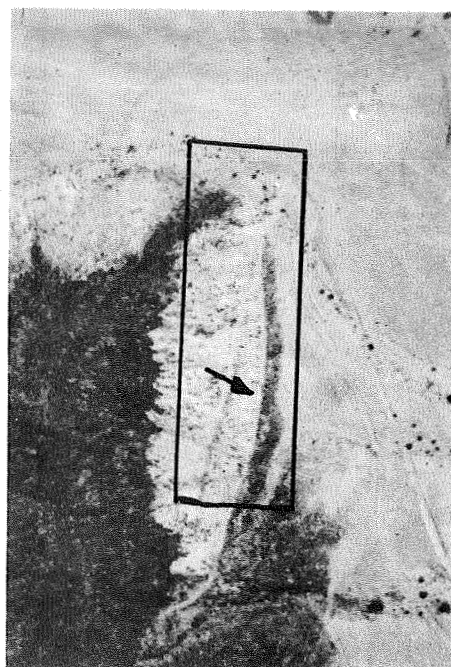
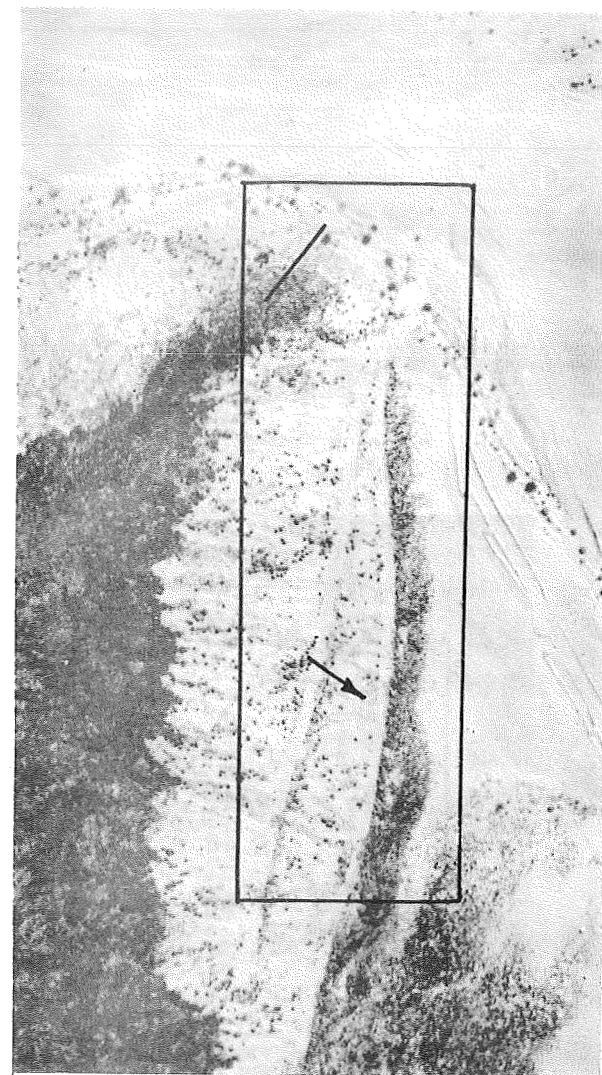


FIGURE 40. Ogilby Hill Rock Course. Left, 3000 feet; top right, 2000 feet; bottom left, 4000 feet. (1) 45 percent slope. (2) Individual rocks.

3.9 REFERENCES

a. F. E. Northon, Engineer Design Test (Block I) of Mobility Test Article Model Bx-1, Yuma Proving Ground, Arizona. June 1967.

b. F. E. Northon, Engineer Design Test (Block I) of Mobility Test Article Model GM-1, Yuma Proving Ground, Arizona. July 1967.

c. F. E. Northon, Test Plan, Engineer Design Test of Mobility Test Articles (MTA's). July 1966.

d. Project OTTER (Overland Train Terrain Evaluation Research) Pretest Report, Technical Report No. 3-588, Report 1, December 1961. U.S. Army Engineer Waterways Experiment Station, Corps of Engineers, Vicksburg, Mississippi.

3.10 DISTRIBUTION LIST

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